

## The role of non-invasive camera technology for gait analysis in patients with vestibular disorders

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### Published version

DIMITRIADIS, Panagiotis, DUNN, Marcus and RAY, Jaydip (2017). The role of non-invasive camera technology for gait analysis in patients with vestibular disorders. In: IFOS (International Federation of Oto-Rhino-Laryngological Societies) World Congress, Paris, France, 24-28 June 2017.

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**E-posters abstract book**  
**EQUILIBRIUM**

## EQ-C-01

### **“SO STONED”: a guiding history taking tool to support the identification of vestibular disorders in the dizzy patient**

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We here present a mnemonic tool to facilitate the identification of the appropriate vestibular diagnosis, based on 8 questions. History taking plays a key role to unravel the aetiology behind the complaints of a dizzy patient. The key factors that allow a first approximation of diagnosis identification are based on the time profile, symptom profile and trigger profile of the disease. The here proposed mnemonic “SO STONED” comprises eight different dimensions that characterise the vertigo-related complaints of the patient and guide the clinician in his or her decision scheme. All the letters “SO STONED” have a specific meaning: Symptoms, Often (Frequency), Since, Trigger, Otology, Neurology, Evolution, Duration. Since the most common vestibular diseases have different fingerprints when all dimensions are considered, this tool can facilitate the differentiation of different aetiologies. We present a table with the following diseases that all have a different SO STONED fingerprint: For the Acute Vertigo: Vestibular Neuritis/Labyrinthitis, Stroke (cerebellar, brainstem). For the Episodic Vertigo: BPPV, Meniere’s disease, Vestibular Migraine, Vestibular Paroxysmia, Semicircular Canal Dehiscence and Mal de Debarquement syndrome. For the Chronic Vertigo: Persistent Postural Perceptual Dizziness (PPPD) and Bilateral Vestibulopathy.

As an example we give the following SO STONED history of a 35 year old woman:

- **S (Symptoms):** vertigo spells
- **O (Often):** some periods daily, some times a couple of times per month
- **S (Since):** 1 year ago it started
- **T (Triggers):** moving around but the vertigo spells can come also spontaneous
- **O (Otology):** negative
- **N (Neurology):** some times head ache, migraine in the past, photophobia, motion sickness
- **E (Evolution):** ups and downs
- **D (Duration):** Usually minutes to hours

This is suggestive for Vestibular Migraine. This scheme helps the pattern recognition of the clinician and guides the history taking.

Obviously, the SO STONED history taking should be completed by full clinical examination, family history taking, medication usage and other tests such as audiometry, vestibular evaluation and imaging, when appropriate.

**EQ-C-02**

## **ANTERIOR SEMICIRCULAR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO**

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**Benign paroxysmal positional vertigo is one of the most common disorders, with characteristics depending on the canal affected. The anterior canal variant is not as rare as it is said to be. We tried to document the diagnosis and treatment of patients in our Private office.**

**We have examined 65 patients with benign paroxysmal positional vertigo. 43 were women and 22 were men. Using the McClure diagnostic method we proceeded to the treatment. We used Baloh's, Asprella's and Gufoni's method of treatment according to the physical parameters of the patients. We used by 30 patients the Baloh's method, 22 Asprella's method and by the rest the Gufoni's method. We used each method twice or three times to different sessions for each patient, until resolve of the symptoms and absence of nystagmus in the diagnostic method. Remission of the vertigo is documented in 23 patients, which was treated again with one of the above mentioned therapeutic methods.**

**Baloh's therapeutic method is very effective, but it requires cooperation of the patients with the doctor. Gufoni's and Asprella's methods are also effective and can be applied, also, to patients with severe symptoms of vertigo or very obese patients. Maybe the combination of different methods could be the key to the therapy.**

**Associations between balance confidence and the history of falls, anxiety and depression in patients with unilateral vestibular system dysfunctions.**

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**PURPOSE OF THE STUDY:**

Falls and fall-related comorbidities are one of the most important public health concerns for all ages. The fear of experiencing a fall is a well-known fall-related factors and patients with vestibular disorders experience a decrease in confidence in performing daily life activities and situations which may lead to falls, decreasing physical independence. The objective of this study is to analyze the association between balance confidence in performing daily life activities and anxiety, depression and history of falls in patients with subacute and chronic unilateral vestibular system dysfunctions.

**MATERIALS AND METHODS:**

A total of 94 patients agreed to voluntarily participate in this cross-sectional study.

History of falls was assessed by number of falls experienced in the last 12 months and depression and anxiety (diagnosed in the psychiatry service of the hospital) were collected by interview. In order to assess the level of confidence in performing daily activities, we employed the Activities-specific Balance Confidence scale (ABC), which Spanish version has been recently validated in this population. The questionnaire has 16 items and the total score of the ABC ranges from 0-100, where a higher percentage higher self-confidence.

**RESULTS:**

Our results indicated that there were no statistical differences in the level of balance confidence with respect to anxiety and depression, whereas participants who experiences at least one fall or more in the last 12 months showed significantly lower confidence in performing daily activities ( $p < 0.013$ ).

**CONCLUSIONS:** Our finding suggests that balance confidence in performing daily life activities is significantly worse in patients with a history of falls in patients with subacute and chronic unilateral vestibular system dysfunctions. No significant differences were observed regarding anxiety and depression.

**Associations between balance confidence and the impact of dizziness in patients with unilateral vestibular system dysfunctions.**

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**PURPOSE OF THE STUDY:**

The objective of this study is to analyze the association between balance confidence in performing daily life activities and the impact of dizziness on health related quality of life in patients with subacute and chronic unilateral vestibular system dysfunctions.

**MATERIALS AND METHODS:**

A total of 94 patients agreed to voluntarily participate in this cross-sectional study. All participants attended the otorhinolaryngology services of Eastern Andalusia.

The impact of dizziness on quality of life was assessed by the Dizziness Handicap Inventory (DHI). In this study the Spanish version of the DHI has been employed. It consists of 25 items divided in three separate subscales: physical (DHI-P), emotional (DHI-E), and functional (DHI-F). According to the DHI total score, the level of disability associated to dizziness was classified into: mild (0-30), moderate (31-60) and severe (61-100). In order to assess the level of confidence in performing daily activities, we employed the Activities-specific Balance Confidence scale (ABC), which Spanish version has been recently validated in this population. The questionnaire has 16 items and the total score of the ABC ranges from 0-100, where a higher percentage higher self-confidence.

**RESULTS:**

The DHI total score, those participants with a mild impact of dizziness on health related quality of life showed a significant better balance confidence than those with moderate ( $p= 0.001$ ) and severe ( $p< 0.001$ ) impact of dizziness.

**CONCLUSIONS:** Our finding suggests that balance confidence in performing daily life activities is significantly better in those with mild impact of dizziness on health related quality of life in patients with subacute and chronic unilateral vestibular system dysfunctions.

### **Audiovestibular damage after electrical injury**

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**Purpose of the study:** To investigate the impact of electrical injury on the inner ear after direct contact with an electrical source.

**Materials-methods:** We present the case of a 62-year-old male patient, an electrician by profession, who was hit by a high-voltage electrical current while working with cables in proximity to a wet floor. The patient suffered from immediate loss of consciousness and five days later he started complaining of slight hearing loss, persistent vertigo, instability and bilateral tinnitus. The neurotological examination comprised tonal audiogram, otoacoustic emissions, auditory brainstem responses, rotatory test, VEMP's and caloric test.

**Results:** According to the results, an extensive bilateral vestibulocochlear dysfunction was detected. After one year, the patient was functional in everyday activities as he could manage his balance problems. However, the instability was deteriorated with the eyes closed; and consequently, he felt unable to work as his job required coping with heights. The tinnitus was still present although it did not bother him. At that time, the vestibular tests showed a persistent vestibular deficiency, complete absence of VEMPs on both sides and absence of compensatory eye movements in the rotational test. The pure tone auditory thresholds remained unchanged and the ABRs revealed prolongation of the absolute latency V and inter-peak latency III-V on the right side, respectively.

**Conclusion:** The exact pathogenetic mechanisms of inner ear dysfunction after electrical injury have not been fully elucidated, although it is believed that there is significant improvement with time. Long-term follow-up, medical assistance and psychological support are crucial factors for the patient management.

## Benign paroxysmal positional vertigo in sudden sensorineural hearing loss

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The annual incidence of sudden sensorineural hearing loss ranges from 5 to 20 cases per 100,000 individuals per years in united states. These factors currently known include initial degree of hearing loss, time from onset to treatment, age, type of hearing loss, vertigo.

Incidence of sudden sensorineural hearing loss accompanied by vertigo is 40% to 60%. In this study, we analyze association between recovery and benign paroxysmal positional vertigo of sudden sensorineural hearing loss patients. We retrospectively reviewed charts of patients who were diagnosed with sudden sensorineural hearing loss from January 2011 to December 2015 at keimyung university dongsan medical center. we found that sudden sensorineural hearing loss with BPPV ( benign paroxysmal positional vertigo) had poor prognosis than others without vertigo. Compared with sudden sensorineural hearing loss only patients, groups with ipsilateral side BPPV ( benign paroxysmal positional vertigo)s and group with subjective vertigo were reported worse initial average PTA and post treatment average PTA.

BPPV could cause by migration of otolith into semicircular canals, it might be a factor that means severe labyrinth damage<sup>1</sup>. This indicate sudden sensorineural hearing loss patient who had BPPV could have more severe labyrinth damage then we could suppose that patients would show poor recovery.



**EQ-C-07**

## **BENIGN PAROXYSMAL POSITIONAL VERTIGO, REVIEW OF CASES AND ITS RELATION WITH THYROID DISORDERS.**

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### **OBJECTIVE**

To assess the age, sex, type and location of the lesion, progression, recurrency and to determine the relations with thyroid disorders both hypo and hyperthyroidism

### **RESOURCE AND METHOD**

Observational and retrospective study of 120 patients with Benign Paroxysmal Postural Vertigo who attended the consultation at the Otorhinolaryngology Head and Neck Surgery Service of the Instituto de Prevision Social-Hospital Central; Asunción - Paraguay during the period of January 2015 to January 2016. All were submitted to thyroid profile tests (FT3-FT4-TSH).

### **RESULTS**

Total of patients obtained 120 , with an average age of 59.4 +/- 18.6 (26 to 82 years), 70% of these were women.

The main affected area was the posterior conduit with a 92.5%, and the horizontal with a 7.5%, there were no case registrated affection of the semicircular anterior canal nor the mutichannel canal. The right labyrinth was the most affected, being the Epley´s manoeuver the most frecuently used. The recurrence of the cases was 9%; As for the etiology, the traumatic event triggered the condition in 25% and in 75% of the cases of unknown cause. The association of paroxysmal vertigo and thyroid disorder was 25%, being the hyperthyroidism in 100% of cases.

### **CONCLUSION**

The benign paroxysmal positional vertigo is one of the most common vestibular disorder, with a high predominance to the female sex, having this as a premise, we consider very important its relation with thyroid disorders, specifically with hyperthyroidism, which is present in a very high and considerable percentage.

Frequently involves and affects the posterior semicircular canal of the right labyrinth. In most of the cases it is of an idiopathic cause, and the treatment with replacement maneuver has 90% of average success. Our results agreed with the literature.

### **AUTHORS**

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## **BENIGN PAROXYSMAL POSITIONAL VERTIGO: RELATION with OSTEOPENIA and OSTEOPOROSIS**

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**Background:** Benign paroxysmal positional vertigo (BPPV) is the most common inner ear cause of dizziness with mostly unknown etiology. **Objective:** The aim of this study was to elucidate an association of osteopenia / osteoporosis, as a disease of disturbed calcium metabolism, with idiopathic BPPV. **Methods:** Twenty six patients (age ranged from 24 to 60 years) with a confirmed diagnosis of idiopathic BPPV (IBPPV) underwent Dual-energy x-ray Absorptiometry (DXA) to assess the bone mineral density (BMD) of lumbar, hip and forearm regions. The BMD and The DXA T scores were compared with those of 36 age and sex matched control subjects selected randomly not complaining of dizziness. The duration and frequency of BPPV were compared with the DXA scan T score. **Results:** The prevalence of osteopenia / osteoporosis in the study group (76.9%) was higher than that in the control group (52.7%). When compared with the control group, patients with IBPPV had a significant lower BMD of lumbar and hip regions as well as a significant lower T score in lumbar region only. There was insignificant correlation between duration and frequency of BPPV attacks and osteopenia / osteoporosis. **Conclusion:** Disturbance in calcium metabolism in osteopenia and osteoporosis might be associated with idiopathic BPPV. The lumbar DXA scan T score is more reliable in the diagnosis of osteopenia / osteoporosis in IPBBV. Further research is needed in the effectiveness of restoring normal calcium metabolism on preventing recurrence of BPPV.

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**EQ-C-09**

## **BPPV associated to cervical pain**

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### **Objetives**

To evaluate the BPPV in patients referred to the Rehabilitation Service of the Hospital Universitario Insular de Gran Canaria (HUIGC) by vertigo, and the influence of cervical pain in the outcome

### **Material and method**

We performed a retrospective study in a cohort of patients referred between January 2015 and June 2016. Exclusion criteria were: unknown etiology, no treatment observance and low cognitive status.

We analyze : sex, age, reason for consultation, duration of vertigo/dizziness neck pain, duration, cervical myeloradiculopathy signs, initial and final DHI scores, affected semicircular canals, treatments (canal repositioning manouever (CRM), vestibular rehabilitation (VR) , and cervical rehabilitation (CR).

Data analysis: means and standard deviation (SD), frequencies and median and interquartile range (IQR) were determined for parametrical and non-parametrical variables, respectively. Chi-square ( $\chi^2$ ), Wilcoxon and Kruskal-Wallis tests were used for analyzing non-parametrical variables and anova F-test for parametrical.  $p < .05$  was consideres as statistical significance. Data were analyzed using the R package, version 3.3.0 (R Development Core Team, 2016).

### **Results**

Eighty eight patients were evaluated. 52,3% of them had BPPV. 71.59% of the total of the sample had performed previous treatments. BPPV patients: a) 100% received drugs (antivertiginous and analgesics), b) 24% had performed no sucessful cervical rehabilitation, c) 62.2% had their clinical problem between 6 months and 3 years. Cervical pain was present in 69.57% of the BPPV patients but there were no differences with other patients ( $p = 0.3$ ). Myeloradiculopathy were present in 5.9% out of 33 patients, and 94.1% of them were mechanical cervicalgias nonspecific. Specific cervical treatment was required only in 12% of patients. Neck pain have not repercussion on MRP efficacy ( $p = 0.01515$ )

### **Conclusion**

BPPV is still underdiagnosed. Cervicalgia is a frequent symptom no related with the effectiveness of the MRP. Only a small number of patients requieres complementary treatment for cervical pain after MRP.

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## EQ-C-10

### Case report- BPPV in Meniere's disease patient

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**Authors :** MUDr. Maja Střiteská, prof. MUDr. Viktor Chrobok, CSc., Ph.D. , University Hospital Hradec Králové

**Abstract :** How to manage BPPV in Meniere disease patients ? Do they respond to BPPV treatment manoeuvres as well as BPPV isolated patients? Are there any special things to focus on in treatment Meniere disease patients suffering from underlying BPPV?

This poster is done for to introduce one case report about the patient suffering from Meniere's disease and also who had underlying BPPV on the same side- ear. The treatment of BPPV in this Meniere's patient was firstly unpleasant for long time period , but with changing the management of treatment and of the type of manoeuvre for posterior SCC- BPPV patient firstly developed acute Meniere's attack , but only short lasting , and than the treatment of BPPV ended successfully.

In discusion we would like to focus on the possibility of BPPV beeing one of the trigger of acute Meniere's attack. And to start discussion about which manoeuvre seems to be the best in focusing to safety and effectiveness in treating the posterior SCC- BPPV in Meniere's patients. We'd like to discuss – which manoeuvre to manage in posterior canal BPPV in Meniere's patients. Epley, which is much more on gravity principle or Semont which is much more on dynamic principle? And why?

## **Clinical Implication and Proposed Mechanism of Direction Changing Vibration Induced Nystagmus (DC VIN) in Unilateral Vestibular Hypofunction**

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### **Purpose:**

The aim of this study was to evaluate the clinical characteristics and vestibular function of patients with DC VIN and unilateral vestibular hypofunction. We also aimed to suggest the clinical implication and the mechanism of DC VIN.

### **Materials and methods:**

The VIN of 315 patients were retrospectively analyzed. 18 patients (5.7%) were found to have DC VIN. 15 patients (4.8%) were diagnosed as unilateral vestibular hypofunction on vestibular function test (caloric or rotation chair test (RCT) or HIT). The mean age of the subjects was  $67.8 \pm 10.8$  years (8 females and 7 males).

### **Results:**

When the vestibular function test was analyzed, all the patients had a unilateral vestibular hypofunction. Although the final diagnosis was Vestibular Neuritis (VN) in all the subjects, caloric test was normal in 9 subjects and abnormal in 3 subjects. The character of dizziness was acute attack of vertigo in 7 subjects and mild onset with vague dizziness in 8 subjects. The DC VIN was ipsilateral in 7 subjects and contralateral in 8 subjects. Most of the patient (75.5%) had a mild vestibular asymmetry (Normal caloric test and Abnormality in RCT and/or HIT). In patients with abnormal caloric test (25.0%), compensation was already in progress. That is, normal compensation or over compensation was demonstrated by RCT. Ipsilateral DC VIN was found when the vestibular asymmetry was small and the interaural attenuation of vibration was large. The small vestibular asymmetry seemed to potentiate the effect of interaural attenuation induced nystagmus. Conclusion:

Contrary to previous reports, DC VIN was also found in patient with unilateral vestibular hypofunction. DC VIN was found in patients who were diagnosed as mild VN or definite VN in process of compensation. That is, all patients had a mild vestibular asymmetry. The mechanism of ipsi DC VIN may be due to the large interaural attenuation (IA) of vibration that exceed the amount of vestibular asymmetry.

## Clinical Localization of Horizontal Canal Benign Paroxysmal Positional Vertigo

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**Objective:** Recently, bow-lean test (BL) was introduced to help correct localization of horizontal canal benign paroxysmal positional vertigo (HC-BPPV). However, there has been discrepancy between the supine roll test (SR) and BL results in some cases. The aim of this study was to reveal whether the BL indicates the lesion side more accurately than SR in case of discordance between the tests. **Methods:** Medical records of 188 HC-BPPV patients were reviewed. Patients who have undergone both BL and SR were selected for analysis. Application side of particle reposition maneuver was judged from SR in case of discordance. They revisited the clinic within a week to see the nystagmus change. Early recovery rate and change in involved canal was assessed to find any difference between the discordance (group D) and accordance (group A) patients. Patients with multi-canal BPPV or co-existing other vestibular disorder, secondary BPPV, and central neurologic problem were excluded. **Results:** Total 78 patients of HC-BPPV were enrolled in this study. Male to female ratio was 20:58 and average age was 55.5 (25~89) yrs. Direction changing apogeotropic nystagmus was shown in 49 and geotropic in 29 patients at initial visit. Remission rate at second visit was 31.8% in group D (n=22) and 62.5% in group A (n=56) (p=0.022). Involved canal change to opposite side at follow-up tests was shown in 10/22 (45.5%) on group D and in 5/56 (8.9%) on group A (p=0.001). **Conclusion:** Localization of affected canal by BL should be first considered for the early recovery of HC-BPPV

## COMORBIDITIES IN VESTIBULAR NEURITIS: IS THERE A LINK WITH VASCULAR EVENTS?

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**Purpose of the study:** Vestibular neuritis is a sudden loss of peripheral vestibular function, without cochlear and neurological findings. Seasonal variations in its incidence may indirectly support a viral etiology of vestibular neuritis. However, certain authors have also postulated that an ischemic process might be relevant for the etiology of this disease. Thus, the aim of this study is to analyze the comorbidities in vestibular neuritis, the seasonal variability and the occurrence of acute vascular events after the vertigo crisis.

**Materials and methods:** A retrospective cohort study of 231 patients admitted with the principal diagnosis of vestibular neuritis in a tertiary hospital between 2011 and 2013 was conducted with follow-up until 2016. For each subject the comorbidities and the occurrence of an acute vascular event were recorded. The demographic characteristics and comorbidities were analyzed using chi-square test. The survival study was carried out with Kaplan-Meier curves and long rank test was used for comparison. Multiple logistic regression was used to control for possible confounders. The seasonal variability of vestibular neuritis was tested with chi-square test and Rayleigh test.

**Results:** From the 231 vestibular neuritis patients, cardiovascular risk factors were present in 92 patients (40%) and 15 (6.5%) acute vascular events (stroke or acute myocardial infarction) were observed during the follow-up period. Patients with hypertension and hypercholesterolemia showed a significant association with acute vascular events ( $p < 0.05$ ). In our cohort, significant seasonal variability was not observed.

**Conclusions:** Patients with vestibular neuritis present a high prevalence of cardiovascular risk factors with significant association with the occurrence of vascular events. Risk control should be mandatory for elderly vestibular neuritis patients. Although the viral etiology has been more often highlighted, the absence of seasonal variability in our cohort can support the importance of vascular etiology in vestibular neuritis.

## Comparison between objective and subjective benign paroxysmal positional vertigo: clinical features and outcomes

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**Objective:** To examine differences in demographic and clinical features, as well as treatment outcomes, between objective benign paroxysmal positional vertigo (O-BPPV) and subjective BPPV (S-BPPV).

**Methods:** The medical records of 134 patients with BPPV were reviewed for demographic characteristics, past medical history, associated symptoms, response to CRMs, interval between symptom onset and the first medical visit, and recurrence rate. The O-BPPV group (n=101) comprised patients who experienced vertigo and accompanying autonomic symptoms, and showed typical nystagmus. The S-BPPV group (n=33) comprised patients who, when subjected to a provoking manoeuvre, showed all of the classic BPPV symptoms but did not show nystagmus. All patients had at least 3 years of follow-up.

**Results:** The demographics (age and sex ratio), past medical history, and associated symptoms were not significantly different between the two groups. Posterior semicircular canal BPPV appeared more than twice as often as horizontal semi-circular canal BPPV in patients with S-BPPV. However, both canals were affected to a similar proportion in patients with O-BPPV, and the difference was marginally significant ( $p=0.073$ ). Overall improvement was better in O-BPPV than in S-BPPV; however, there was no significant difference. The total numbers of manoeuvres for recovery and the interval between symptom onset and the first medical visit also did not show any significant inter-group differences. During a 3-year follow-up, the recurrence rate was 13.8% for O-BPPV and 21.2% for S-BPPV.

**Conclusions:** O-BPPV and S-BPPV have similar demographic and clinical features. Canalith repositioning manoeuvres (CRMs) can be an effective treatment for patients with S-BPPV, and a diagnosis of positional nystagmus is not essential for considering CRMs. This study supports the use of CRMs as the primary treatment for S-BPPV.



## Dynamical analysis of balance in vestibular schwannoma patients

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**Purpose of the presentation:** Postural control relies on feedback from the visual, vestibular and somatosensory systems. The alteration of one of these systems can lead to postural instability. This degradation arises notably in patients with vestibular schwannoma (VS). VS is a benign tumor whose slow-growth and surgical resection lead to a degradation of postural control, which is progressively compensated by central adaptive mechanisms. Recent methods for assessing the efficiency of postural control were developed and are based on the quantification of complexity of the postural signal. In this context, complexity relates to the irregularity of the center of pressure time series and characterizes the ability of postural control to meet changing environment. According to the theory of complexity loss, the deterioration of physiological systems leads to a decrease in complexity. Thus, the aim of this study was to evaluate the effect of VS and its treatment on the complexity of center of pressure time series.

**Material and methods:** Thirty-nine participants took part in the protocol and were divided into two groups: the VS group (n=19) with unilateral VS who were scheduled for surgical ablation using translabyrinthine approach. Patients were compared to a healthy control group (n=20). The patients performed postural assessment three days before surgery and three times after surgery, at eight, thirty, and ninety days. Participants enrolled in the control group underwent posturographic tests only once. The SampEn method was used to quantify the complexity of postural fluctuations.

**Results:** Before surgery, the complexity of postural fluctuations in the VS group was lower than that of the control group ( $p < 0.001$ ), in postural tasks where vestibular afferences significantly contribute to maintaining balance. The surgical resection of the tumor led to an immediate decrease of complexity ( $p < 0.05$ ), which is progressively restored over time ( $p < 0.05$ ) to such an extent that no difference was found between the two groups ninety days after surgery.

**Conclusion:** VS and its surgical ablation led to a decrease in complexity of postural fluctuations, indicating an inability of the postural system to adapt to a constantly changing environment involving a risk of falling. Then, central adaptive mechanisms were developed to restore a level of complexity allowing patients to meet constraints. Thus, the complexity analysis is able to highlight the postural effects of vestibular pathology, and appears to be a valuable tool for the diagnosis of vestibular dysfunction.

## EQ-C-16

### **Dysfunctional otolith system causes a blood pressure drop in astronauts returning from space**

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It is a challenge for the human body to maintain stable blood pressure while standing. The body's

failure to do so can lead to dizziness or even fainting. For decades it has been postulated that the

vestibular organ can prevent a drop in pressure during a position change – supposedly mediated by

reflexes to the cardiovascular system. We show – for the first time – a significant correlation between

decreased functionality of the vestibular otolith system and a decrease in the mean arterial pressure

when a person stands up. Until now, no experiments on Earth could selectively suppress both otolith

systems; astronauts returning from space are a unique group of subjects in this regard. Their otolith

systems are being temporarily disturbed and at the same time they often suffer from blood pressure

instability. In our study, we observed the functioning of both the otolith and the cardiovascular

system of the astronauts before and after 6 months of spaceflight. This was achieved by centrifugation of the subject on a mini centrifuge followed by an operational tilt test. All experiments were performed in a ESA lab located in Star City near Moscow. Our finding indicates that an intact otolith system plays an important role in preventing blood pressure instability during orthostatic challenges. Those cosmonauts that had however a distinct reduced otolith ocular reflex during centrifugation, indicating a hampered otolith system, also had more difficulties in maintaining their mean arterial pressure during the tilt test. There was a significant correlation between the otolith reflex during centrifugation and the mean arterial

pressure change during the tilt test ( $r=0.67$ ,  $p=0.018$ ) when preflight data were subtracted from post flight data. As such, the effect of spaceflight could be identified.

Up to date, little cross breeding between the fields of cardiovascular and vestibular sciences exists.

Our finding not only has important implications for human space exploration; they may also improve

the treatment of unstable blood pressure here on Earth by studying the vestibular system.

## **Early Vestibulospinal Reflex Changes in Type II Diabetes Mellitus in Relation to Peripheral Neuropathy**

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**Introduction:** Most of diabetes mellitus (DM) patients complain of imbalance and/or dizziness. **Aim of this study:** To assess the cervical vestibular evoked myogenic potential (cVEMP) in diabetic patients as an indicator of the integrity of the vestibulo-spinal reflex (VSR) that plays a pivotal role in balance function. **Methods:** Forty adult patients with type II DM underwent cVEMP. Results of these tests were compared with those of 40 age and gender matched control subjects. Both patients and controls were not known to have neither peripheral nor central vestibular disorders. The grade of neuropathy, level of HbA1c and duration of DM were compared with vestibular tests results. **Results:** Patients had higher cVEMP threshold with longer P13 and N23 waves' latency than controls. Neuropathic patients, patients with poorer glycemic control and patients with disease duration > 5 years had significant higher cVEMP threshold and prolonged waves latencies in both ears than other patients. Severity of neuropathy had the strongest correlation with cVEMP results followed by level of HbA1c and finally the disease duration. **Conclusions:** diabetic patients have altered VSR in the form of delayed waves and elevated threshold of cVEMP response which is correlated with neuropathic changes found in these patients. DM affects both labyrinthine and retro-labyrinthine parts of the VSR pathway. Diabetic patients have a subclinical vestibular deficit that may appear with progression of diabetic complications.

**Authors:**

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## **EQ-C-18**

### **Endolymphatic hydrops in patients with unilateral and bilateral Meniere's disease**

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#### **Purpose of the study**

To evaluate the endolymphatic hydrops (EH) on both sides in patients with unilateral and bilateral Meniere's disease (MD), and to investigate factors with progression to bilateral MD including the degree of EH, hearing level, and the duration of MD.

#### **Materials and methods used**

The study included 29 patients with unilateral definite MD and 12 patients with bilateral definite MD according to the criteria established by AAOHNS in 1995. The endolymphatic space size was visualized by using 3-Tesla magnetic resonance imaging.

#### **Results**

All patients with unilateral and bilateral MD had significant or mild EH at least in the cochlea or the vestibule on the affected side. On the non-affected side, EH was not observed at all in eight patients, but asymptomatic EH was observed in the cochlea in 14 patients and in the vestibule in 16 patients. There was no relationship between the EH on the non-affected side and the duration of MD.

#### **Conclusion**

All definite MD had EH at least in the cochlea or the vestibule. Symptoms of MD may appear after formation of EH. It is assumed that the probability of immediate progression to bilateral MD from unilateral MD is very low in patients without EH on the non-affected side.

## **Epidemiology of vertigo and dizziness and correlation with headaches**

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**Purpose of the study:** Vertigo and dizziness are common symptoms in the general population, with an estimated prevalence between 20% and 56%. The aim of our work was to assess the point prevalence of these symptoms in a population of 2672 subjects.

**Materials and methods:** Patients were asked to answer a questionnaire; in the first part they were asked about demographic data and previous vertigo and or dizziness; in the second part they were asked about the characteristics of vertigo and lifetime presence of moderate to severe headache and its clinical features.

**Results:** A total of 1077 (40.3%) subjects referred vertigo/dizziness during their lifetime, and the mean age of the first vertigo attack was  $39.2 \pm 15.4$  years; an age and sex effect was demonstrated, with symptoms 4.4 times more elevated in females and 1.8 times in people over 50 years. In the total sample of 2672 responders, 13.7% referred a sensation of spinning, 26.3% relapsing episodes, 12.9% positional exacerbation and 4.8% cochlear symptoms; 34.8% referred headache during their lifetime.

**Conclusion:** 34,8% of patient with vertigo/dizziness referred also headache of migrainous type in their lifetime. Subjects suffering from headache presented an increased rate of relapsing episodes, positional exacerbation, cochlear symptoms and a lower age of occurrence of the first vertigo/dizziness episode.

## Gadolinium MRI in Meniere's disease, vestibular migraine and deafness

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**Objective:** To investigate the gadolinium enhanced MRI in Meniere's disease, vestibular migraine, and sensorineural hearing loss patients.

**Methods:** Seventy-six Meniere's disease cases, 29 vestibular migraine cases and 16 sensorineural hearing loss cases, were conducted with bilateral intratympanic injection of gadolinium contrast agents, 24 hours before MRI Scanning. 3D FLAIR and 3D T2 SE sequences were acquired 24 hours after intratympanic gadolinium injection.

**Results:** 76 cases of MD patients were all revealed endolymphatic hydrops, even the symptoms relieved and the hearing came back normal. Three patients were seen bilateral endolymphatic hydrops, ten ears were only cochlear endolymphatic hydrops, and 7 ears were only vestibular endolymphatic hydrops, 62 ears revealed both cochlear and vestibular endolymphatic hydrops. Only one patient revealed hydrops reduced but still exist after therapy. The diuretics could not change the hydrops. Twenty-nine vestibular migraine patients (6 patients with mild low frequency hearing loss, 23 patients with normal hearing) revealed bilateral no hydrops in 26 patients, 3 patients with unilateral cochlear suspected hydrops. Nine sudden deafness with vertigo patients revealed no endolymphatic hydrops two months to one year after the onset. Four in 7 cases with hearing fluctuation loss, no history of vertigo, revealed endolymphatic hydrops.

**Conclusion:** Endolymphatic hydrops in Meniere's disease were mainly in both the cochlea and the vestibular field. Endolymphatic hydrops could be seen in the whole course, even the hearing recovered and vertigo relieved for months. There was no endolymphatic hydrops in vestibular migraine.

**EQ-C-21**

**Management of examination of dizzy patient- bedside and instrumental examination- VOG, VHIT, VEMP**

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In this lecture I would like to describe how we manage the dizzy patients. First slides are about bedside examination- about taking a history and how to perform the full vestibular bedside examination - description of this examination including examination of nystagmus ( Frenzel goggles - without fixation), gaze nystagmus, the degree of nystagmus, alternating cover test for oculomotor disorders, Romberg, Unterberg, Hautant , is there any ataxia, adiadochokinesis, dysarthria, etc. .... Then we perform full vestibular testing including VOG examination of Spontaneous nystagmus, Gaze nystagmus, Smooth pursuit examination, Saccadic eye movements examination, optokinetic nystagmus. Then we perform VHITs - I also describe how VHIT differs from only bedside HIT, what informations we can achieve from this VHITs more than from bedside HITs . Lecture also includes full description of VHIT analysis , normal VHIT results and pathological VHIT results. Than I also describe VEMPs- both oVEMP and cVEMP , introduction , technique how to perform them , results . At the end of the lecture I also discuss some pitfalls in doing VHITs and VEMPs . This lecture is usefull for starting otoneurological doctors to get more familiar with new equipment in nowadays vestibular testing.

If there are any questions or something to improve, please contact me, thank you very much.  
Maja Striteska



## Meniere's disease: Current diagnosis and pathophysiologic theories

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Meniere's disease, named after Prosper Meniere in 1861, remains a diagnosis based on symptoms despite the availability of reliable objective testing, and regarded as enigmatic as to its pathophysiology. By International agreement the 1995 AAO-HNS Equilibrium Committee definition has been replaced by the Barany Society classification with only two categories: probable and definite, with no recognition of objective certainty by any test. While MRI inner ear imaging has shown promise in visualising endolymphatic hydrops it has not been proved to be completely reliable. Transtympanic tone burst electrocochleography remains the simplest, cheapest and sensitive test for detecting endolymphatic hydrops to confirm a diagnosis of Meniere's disease. Although Schuknecht's endolymph "rupture" theory has been foremost for 30 years there is extensive evidence for an alternative mechanism for the attacks and for the possibility that the basic cause of Meniere's disease is detached saccular otoconia. The history of diagnostic classifications will be outlined, the sensitivity of tone burst electrocochleography compared with MRI inner ear imaging discussed, and the main theories on pathophysiology discussed. Although the new Barany diagnostic classification seeks to simply diagnosis and to conform to International Classification of Diseases criteria it is likely to prolong advances in diagnostic certainty and the confusion between Meniere's disease, vestibular migraine and other causes of recurrent vertigo.

## PERSONALITY TRAITS AND VESTIBULAR DISORDERS

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**Purpose:** Certain personality traits have been connected to the etiology and evolution of various chronic symptoms and diseases. The aim of this study was to evaluate the personality traits of adult patients with vestibular disorders and to check for an association with anxiety, depression and incapacity in relation to the dizziness. **Material and methods:** This is a cross-sectional study involving patients at a public university hospital who were aged between 18 and 65, had dizziness for at least three months and had been diagnosed with a vestibular disorder. The research tools used were: the Personality Factor Inventory (BFP: 'Bateria Fatorial de Personalidade'), the Hospital Anxiety and Depression Scale (HADS) and the Dizziness Handicap Inventory (DHI). **Results:** The 30 patients included in the study had an average age of 48.7 and the majority (90%) were women. The most common diagnosis was vestibular migraine, found in 56.7% of patients. Regarding personality traits, according to The Five-Factor Model, 56.7% of participants had high or very high levels of neuroticism, 53.4% average levels of extraversion, 36.7% high or very high levels of agreeableness and 36.7% high or excessive levels of conscientiousness. As the opening factor, 50% of the sample had very low or low scores. The scores for neuroticism and conscientiousness were higher than the normative population of BFP, while the opening factor showed lower scores ( $p < 0.05$ ). There was a positive and statistically significant correlation ( $p < 0.01$ ) between neuroticism and symptoms of anxiety, depression and incapacity related to dizziness. **Conclusion:** Most of the patients with vestibular disorders presented high levels of neuroticism, which is associated with depression, anxiety and incapacity in relation to dizziness.

## **Positional dizziness among elderly predicts unrecognized benign paroxysmal positional vertigo**

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### **Purpose:**

**Dizziness and unsteadiness of gait is a common complaint, which increases with increasing age. Benign paroxysmal positional vertigo (BPPV) is the most common cause of dizziness originating from the vestibular organ and the prevalence of the disease/condition varies in the literature. Dizziness when turning over in bed is strongly correlated to BPPV. This study aims to investigate and assess the prevalence of dizziness and dizziness when laying down or turning over in bed, the persons dizzy in bed underwent an investigation for BPPV. A secondary aim was to investigate impaired balance and intake of medications among citizens aged 70-85 years.**

### **Material and Method:**

**In this cross-sectional study, 498 people (male to female ratio 1:1) aged 70-85 were asked to fill out a study specific questionnaire about symptoms of dizziness and dizziness when turning in bed and to list their medications. Persons who answered they became dizzy when laying down or turning over in bed were asked to participate in a physical examination aimed at dizziness and focusing on BPPV by a medical doctor at the department of Otorhinolaryngology Head and Neck Surgery at Södra Älvsborgs Hospital.**

### **Result:**

**A total of 324 participants answered the questionnaire. More than one quarter (29%) of the participants reported they had problems with dizziness and 10% (n=32) reported they got dizzy when laying down or turning in bed. Of these, 21 came for a physical investigation and diagnostic manoeuvres whereof 14 reported current dizziness when turning in bed, always or sometimes. A total of six tested positive for BPPV, leading to an overall prevalence of 1,9%. Dizziness increased significantly with age and with increasing number of medications.**

### **Conclusion**

**Asking about dizziness when turning over in bed is an easy way to identify elderly with BPPV. Dizziness when turning in bed is common among elderly and were found in 10%. Supine dizziness is more often seen than positive eye motor findings for BPPV. Secondly, dizziness and unsteadiness of gait increase significantly with higher age and increase with intake of medications.**

## **Post-Earthquake Dizziness Syndrome**

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**We purposed to research the epidemiology and physiology of the dizziness phenomenon a number of people suffer after the huge earthquakes. A few reports of dizziness after the earthquakes were seen so far, but we purposed the universal mega data analyze using plural huge earthquakes.**

**We underwent the same type of questionnaire research after two huge earthquakes in Japan in the year of 2011 and 2016. We analyzed over five thousand peoples' data and elicited the epidemiological and physiological feature of them.**

**The epidemiological and physiological features of the dizziness symptoms after those two huge earthquakes revealed similar tendency. Almost 70% of Japanese people in those earthquake areas had experienced the dizziness and we named them "Post-Earthquake Dizziness Syndrome (PEDS)".**

**A number of people had experienced unsteady and rolling sensation after the huge earthquakes. The certain effects from the huge earthquakes considered to influence the people even after them. Those PEDS seemed to occur universally when the magnitude exceeds some huge threshold. We analyzed those phenomena mainly induced by vestibular, somatosensory and psychological elements.**

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**Post-irradiated sudden deafness (PISD) in nasopharyngeal carcinoma patient -- a twenty-year experience**

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**Purpose of the study**

To investigate the incidence and prognosis of sudden hearing loss as well as inner ear injury by radiation in patients with nasopharyngeal carcinoma (NPC) who were treated by intensity-modulated radiotherapy (IMRT) and compared with those who were treated by two-dimensional radiotherapy (2DRT). A retrospective study in the past two decades was performed comprising NPC patients with sudden hearing loss who underwent IMRT or 2DRT.

**Materials and methods used**

Twenty-nine (30 ears, 2%) out of 1570 patients who received 2DRT had PISD and were assigned to Group A. In contrast, 3 (4 ears, 0.2%) of 1636 patients who underwent IMRT had PISD and were assigned to Group B. All patient had identical treatment with dextran. To evaluate the prognosis, their hearing level was measured twice: at the diagnosis of sudden deafness and 3 months later after treatment. We compare the incidence, radiation dose and prognosis between these groups.

**Result**

There was no significantly difference in the gender proportion (M/F: 2:1), mean age ( $p= 0.985$ ), radiation dosage ( $p=0.521$ ), interval between completion of the radiotherapy and sudden deafness ( $p=0.788$ ). The incidence of sudden deafness in group A (2%) was greater than group B (0.2%). The dosage of radiation delivered to cochlear of each group was estimated as 70% and 50% of treatment dose. The mean hearing level recovery of group B showed significant improvement (pre-treatment:  $90\pm 20$ db, post-treatment:  $60\pm 20$ db,  $p= 0.003$ ), however, no significant difference in group A. Thus the PISD prognosis treated by IMRT was better than conventional radiotherapy.

**Conclusion**

Sudden deafness in NPC patients treated by IMRT showed significantly lower incidence (0.2% V.S. 2%), lower radiation insult (50% V.S. 70%) and better prognosis when compared with those treated by 2DRT, demonstrating the superiority of IMRT in decreasing sudden deafness.

## Recurrent Spontaneous Vertigo with Vigorous Interictal HSN: A New Disorder?

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**Objective:** To describe a new clinical entity characterized by recurrent attacks of spontaneous vertigo and vigorous interictal head-shaking nystagmus (HSN) without any other evidences of peripheral or central vestibulopathy.

**Methods:** From July 2004 to December 2015, we have seen five patients with recurrent attacks of isolated spontaneous vertigo and vigorous interictal HSN (peak slow phase velocity >50°/s) in the absence of any other features that meets the diagnostic criteria of the disorders characterized by recurrent spontaneous vertigo. We analyzed the clinical characteristics and patterns of HSN in these patients.

**Results:** All five patients showed biphasic, long-lasting HSN. The peak velocity of the primary phase of HSN ranged from 66.0 to 84.0°/s. The time constant of the primary phase HSN ranged from 11 to 17 seconds. The HSN was prominent even with brief head-shaking only for 2–5 seconds. None of the patients reported hearing loss, tinnitus, ear fullness or migrainous headache during or between the attacks. Four patients had a history of significant motion sickness. Two patients reported a history of dizziness in the immediate family members. Baclofen and acetazolamide decreased the frequency and severity of the attacks along with a shortening of the time constants of HSN in two patients.

**Conclusion:** The clinical features and characteristics of HSN in our patients indicate unstable and hyperactive velocity-storage mechanism that gives rise to intermittent attacks of spontaneous vertigo probably when decompensated. Head-shaking maneuver should be applied to the patients with benign recurrent vertigo.

## **RECURRENT SPONTANEOUS VERTIGO: DISTINGUISHING ELEMENTS BETWEEN MENIERE DISEASE AND VESTIBULAR MIGRAINE.**

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### **Purpose of the study**

Nowadays Meniere disease and vestibular migraine pose a challenge for the ENT in consultations. Both patient symptoms can be very similar and they are specially difficult to distinguish in the initial stages considering the patient's clinical presentation.

Even though this two pathologies have different physiopathology, evolution and treatment, it is essential the differentiation to obtain better therapeutic results. Our aim is to detect clinical variables and characteristics in vestibular tests which could allow us to differentiate the symptoms.

### **Material and Method.**

#### **Retrospective cohort studies.**

We compare a cohort of 30 patients suffering from vestibular migraine to another of 30 patients suffering from Meniere disease.

We analysed demographic clinical data, hearing thresholds, association of migraine and vertigo, presence of motion sickness and localization of migraine. Furthermore, we compared the caloric (reflectivity, paresia and directional preponderance), auditory and electrocochleography test results in both cohorts.

### **Results**

Characteristic symptoms in Meniere disease and vestibular migraine are distinguishing by themselves in both clinical pictures in the majority of the patients, exceeding the 80% in both cohorts. Nevertheless, there is an overlapping in the clinical basis between both cohorts in the rest of the patients. The audiometry and the electrocochleography represent the most differentiating tests in both groups 83% and 76.6% of sensibility to detect Meniere disease respectively. Global reflectivity do not behave in a different manner between both groups ( $p<0.05$ ). Those patients, who suffer migraine with a bigger association between their vertigo and the migraine, have more reflectivity in caloric testing and a tendency to a significance on statistics.

Directional preponderance and paresia is significantly higher in the group of Meniere disease patients ( $p<0.05$ )

### **Conclusions**

Clinical findings and audiometry are the tests which have a bigger range of information shown to differentiate both groups. However, there are clinical signs that overlap which complicates the differential diagnosis in almost 20% of the cases in which vestibular tests may show useful information.

## **Significance of endolymphatic hydrops in ears with unilateral sensorineural hearing loss**

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**Objective:** The purpose of this study was to use contrast-enhanced magnetic resonance imaging (MRI) to determine the existence of endolymphatic hydrops (EH) in affected and unaffected ears in people with unilateral sensorineural hearing loss (SNHL) and to evaluate the significance of EH to otological disease.

**Study Design:** Retrospective study

**Setting:** University hospital

**Methods:** One hundred ninety-four ears from 97 patients with unilateral SNHL were studied. The endolymphatic space was evaluated using 3-Tesla MRI with gadodiamide hydrate. Imaging data about the degree of EH in the cochlea and vestibule were analyzed and compared between ears with different otological diseases.

**Results:** All affected ears with delayed endolymphatic hydrops (DEH) or mumps deafness had EH. In affected ears with definite MD, cochlear EH was observed in all ears and vestibular EH in 93% of ears, and these rates were significantly higher in the affected than in the unaffected ears. EH was observed in the cochlea and vestibule in 66% and 41%, respectively, of the affected ears with idiopathic sudden SNHL (SSNHL); these percentages did not differ significantly from those in the unaffected ears (52% and 38%, respectively).

**Conclusions:** MRI showed that a high percentage of ears affected by MD, DEH, or mumps deafness had EH. Further studies should reevaluate the implications of EH in ears with SSNHL in terms of secondary and preexisting conditions.



## **Sociodemographic characteristics of patients who consult for instability or vestibular pathology**

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### **PURPOSE OF THE STUDY:**

With this study we want to know the most prevalent pathologies of patients who was attending in our consultation with vestibular alterations or instability as well as their characteristics (level of studies, sex, age, smoking) or concomitant pathologies that had our patients and that may influence the evolution of their current vestibular pathology.

### **MATERIAL AND METHODS:**

This study is a 6-month observational study which sociodemographic data are collected from 94 patients who come to the otorhinolaryngology clinic due to vestibular pathology or instability.

### **RESULTS:**

In our study, 46.8% (n = 44) were men, the mean age of the sample was  $53.43 \pm 11.38$  years. Regarding marital status and academic level, it was observed that the majority of participants were married and had a basic level of education. 79.79% of the participants (n = 75) were not smokers.

Regarding the diagnosis, the five most prevalent diagnoses were: benign paroxysmal positional vertigo (BPPV), which occupied 27.66%, Ménière's disease with the same percentage of patients, followed by patients who presented instability with 22.34% , finally 15.96% of the patients had vestibular neuritis and only 6.38% had vestibular migraine.

In the anamnesis, previous pathologies presented by the patients were collected and the most frequent were depression and anxiety with 58.50 and 50.00% respectively, followed by hypertension with 34.40%, 34% had tinnitus and hypothyroidism and finally 18.09% had cervical pathology diagnosed by a specialist in physical medicine and rehabilitation.

### **CONCLUSIONS:**

These types of studies allow us to know better the characteristics of our patients and to be able to propose future studies.

Regarding the type of vestibular alteration, we could observe BPPV was the most frequently diagnosed pathology along with Ménière's disease, which are the two most common pathologies of peripheral vestibular alterations according to Brandt et al 2013.

## **Symptomatology and vestibular findings in patients with postural orthostatic tachycardia syndrome (POTS)**

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**Purpose:** Postural Orthostatic Tachycardia Syndrome (POTS) is a common autonomic disorder affecting at least 500,000 Americans between 12 and 50 years of age, generally female. Patients with POTS demonstrate failure to compensate appropriately for postural changes, leading to lightheadedness and syncope. Patients with POTS are evaluated routinely in the otology/audiology clinic due to reported dizziness, generally lightheadedness and imbalance. Little is known about the vestibular presentation of patients with diagnosed POTS or the influence of overlapping presentation of POTS with other conditions, such as migraine and persistent postural-perceptual dizziness (PPPD), which increases the complexity of dizziness management. The main objective of this study was to describe the vestibular and dizziness presentation of patients with diagnosed POTS and discuss what may account for dizziness symptoms.

**Materials and Methods:** Retrospective data were collected from 32 patients diagnosed with POTS at Mayo Clinic Arizona from 2013-2016. Patients completed a symptom checklist, anxiety/depression scale, and Dizziness Handicap Inventory. Vestibular evaluations included Computerized Dynamic Posturography (CDP), cervical vestibular evoked myogenic potentials (cVEMPs), and videonystagmography (VNG) testing with caloric irrigations or video head impulse testing (vHIT).

**Results:** The majority of patients reported lightheadedness (84%), imbalance (84%) and rotational vertigo (63%). A significant portion of patients (85%) reported a history of migraine. CVEMPs and VNG were appropriate for the majority of patients (>80%). Balance testing (CDP) was appropriate for 78% of patients. There was no relationship between vertigo and peripheral horizontal canal function, cVEMPs, or CDP ( $p>0.05$ ). Additional analyses will consider the possible comorbidity of migraine and PPPD; case studies will illustrate the various presentations in this cohort.

**Conclusions:** Patients diagnosed with POTS are expected to experience postural lightheadedness; however, a significant proportion also report dizziness with variable characteristics. While over half reported experiencing rotational vertigo, the majority did not exhibit evidence of peripheral vestibular pathology. The mechanism behind the variable dizziness presentation in patients with POTS is unclear, but may suggest atypical central integration consistent with high rates of migraine in this population. In conditions with non-specific findings and overlapping symptomatology (e.g., migraine, POTS, PPPD), the diagnosis is often difficult to isolate and may commonly be the result of symptom presentation, documented case history, and response to treatment. In many cases, these patients are likely to present with overlapping conditions requiring a multidisciplinary team for management.

## The role of neck pathologies in pathogenesis of vertigo/dizziness in adults

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**Rationale and objectives.** Balance disorders coexist with neck complaints in over 40% of dizzy patients. However, a causal relationship between these factors is still debated. The aim of this study was to investigate whether the restriction in neck rotation and increased neck muscle tension may activate the cervical afferent response, which in turn could be linked to vertigo or dizziness of cervical origin (syndrome called “cervical vertigo”). Our hypothesis is supported by the recent findings suggestive of an increased number of mechanoreceptors in the diseased cervical discs of patients with vertigo as compared to patients without vertigo (Yang L. Spine (Phila Pa 1976). 2016 Jul 19. [Epub ahead of print]).

**Methods.** Seventy-eight patients reporting vertigo and/or balance problems were divided into two groups: 53 subjects with (R+) and 25 without (R-) restriction of cervical rotation and painful muscle tension in the flexion-rotation test. Vestibular paresis was excluded in all subjects based on normal caloric test. Main outcome measures were: Videonystagmography (VNG) kinetic tests, VNG cervical torsion test (VNG-CTT) and transcranial Doppler ultrasonography cervical torsion test (USG-CTT).

**Results.** In R+ comparing to R- group, VNG-CTT revealed increased nystagmus velocity and USG-CTT test showed slowing the blood flow in basilar and contralateral vertebral arteries. Increased mean gain of cervico-ocular reflex (COR) in R+ group was observed. The positive relationship between COR and vestibulo-ocular reflex (VOR) was noticed in R+ group only.

**Conclusions.** Increased cervical afferent proprioception could be a possible explanation of vertigo and imbalance in patients with neck pathologies.

**Acknowledgment.** The study was supported by the funds of the Polish National Center for Research and Development; project No STRATEGMED/INNOREH/266299/2016.

## The seasonal variation of benign paroxysmal positional vertigo.

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### Purpose of study

Benign paroxysmal positional vertigo (BPPV) is a condition that is characterised by recurrent episodes of positional vertigo due to dislodged otoconia debris within the semicircular canals. Many studies have proposed a correlation between Vitamin D deficiency and recurrent BPPV. Serum Vitamin D falls for the UK population during the winter, and reaches its lowest level in May. Serum Vitamin D levels then increase to reach its highest level in September. It is our hypothesis that if there is a relationship between BPPV and serum Vitamin D levels, one would expect to see a seasonal variation in the incidence of BPPV amongst UK residents.

### Methodology

A retrospective review of clinic letters and GP referral letters for patients presenting to a University Otolaryngology department over a twelve-month period was performed. Patients with posterior canal BPPV were identified by recording the documentation of a positive Dix-Hallpike manoeuvre. Patients were divided into two groups: those who presented during the UK season associated with low serum Vitamin D levels, and those who presented during the UK season associated with high serum Vitamin D levels. Statistical analysis was performed to determine whether there was a statistically significant difference between the two groups.

### Results

370 patient episodes reporting presentation to the Norfolk & Norwich University Hospital between October 2015 and October 2016 with a history consistent with posterior canal BPPV were recorded. Of this cohort of patients 112 were identified as positively experiencing posterior canal BPPV as a consequence of having had a positive Dix-Hallpike manoeuvre recorded in the clinical notes. An unpaired 2-tailed t-test demonstrated there to be a statistically significant difference between the low serum Vitamin D group and the high serum Vitamin D group ( $p = 0.0169$ ).

### Conclusion

The results of this study confirm that there is a statistically significant difference between the incidence of BPPV in months when serum Vitamin D levels are lower compared to months when Vitamin D levels are higher. This study is important for a number of reasons. Firstly, it adds to the mounting literature that suggests an association between serum Vitamin D levels and BPPV. Secondly, it suggests a therapeutic strategy to improve outcomes in patients with BPPV. Thirdly, it adds significance to the hypothesized role of calcium metabolism for the development of inner ear disease.

## **Toward a new staging for Meniere's disease: vestibular approach**

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Meniere's disease (MD) was staged in the literature using different approaches. The most commonly used one was developed by AAO-HNS (1995), which is dependent on audiometric thresholds (PTA). Four stages are identified: stage I with PTA less than 26 dB, stage II 26-40 dB, Stage III 41-76 dB, and stage IV PTA worse than 70 dB. Obviously, this classification deals with MD as a cochlear illness with complete ignorance of its vestibular impact.

The aim of the study was to test the saccule, the utricle and the three semicircular canals using the new developed audiological diagnostic armamentarium, such as cervical Vestibular-evoked myogenic potential (cVEMP), ocular VEMP (oVEMP) and video head impulse test (vHIT), respectively, in Meniere's patients and to correlate the findings with the different stages of MD. The final aim was to propose a new staging for MD.

### **Materials and methods**

40 patients diagnosed with unilateral definite MD were tested. They were divided into four subgroups according to the stage of MD using the average of 500,1000,2000 and 3000Hz pure tone thresholds of the worst documented audiogram during the 6-month interval before examination. A control group of 40 healthy-age matched adults were equally divided into four corresponding subgroups according to their pure tone average.

500 and 1000-Hz tone burst air-conduction cVEMP and oVEMP tests, bithermal caloric test and video HIT for all semicircular canals were recorded for both groups.

### **Results**

The results of this study showed that, the highest prevalence of abnormalities in Meniere's patients were seen in the PTA (85%) followed by cVEMP (72.5%) then oVEMP (67.5%). Caloric test abnormalities follow with a lower prevalence of 32.5% .The vHIT presented the lowest prevalence of abnormalities with 20% in the lateral canal, 7.5% in the anterior and 5% in the posterior. This pattern of abnormality goes with the reported pattern of hydrops formation in the vestibular system.

### **Conclusion**

The findings of the current study suggested that with the advancement in the stage of MD consequent abnormal cVEMP, oVEMP, caloric and vHIT responses occur in order following the histopathological progression of the disease from the saccule up to the semicircular canals. The authors propose a new staging system that incorporates vestibular involvement in MD.

**Stage (A):** cochlear affection only with abnormal PTA.

**Stage (B):** abnormal PTA & cVEMP.

**Stage (C):** abnormal PTA, cVEMP & oVEMP.

**Stage (D):** abnormal PTA, cVEMP, oVEMP & caloric test.

**Stage (E):** above plus abnormal vHIT.

## **Typical and atypical Cogan's Syndrome: 7 Cases and Review of the Literature**

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### **Objet de la presentation:**

**Cogan's syndrome (CS) is a rare presumed autoimmune disorder characterized by nonsyphilitic interstitial keratitis and progressive audiovestibular symptoms similar to those of Meniere's syndrome.**

**Material and methods:** We reviewed the records of a prospective study, from September 2012 to June 2014, including 7 patients with a Cogan's syndrome. Clinical data regarding age, sex, ethnic origin, presenting manifestations, ocular, audiovestibular and systemic manifestations, treatment and outcome were collected.

**Results:** 7 patients were identified, 3 with typical Cogan's syndrome and the remaining 4 with atypical Cogan's syndrome. The age ranged from 12 to 65 years, with median age of 31 years, The presenting manifestations were ocular in four patients and audio vestibular in three. Examination revealed a bilateral interstitial keratitis (stromal scarring with ghost vessels) in six patients. Which was isolated in three cases and associated in 1 case with conjunctivitis, 1 with subconjunctival hemorrhage and one with corneal neovascularization. Audiovestibular manifestations in the two groups were typical, with vestibular symptoms, followed by progressive hearing loss of variable severity. Five of our patients presented systemic manifestations. All patients initially received local and systemic corticosteroids (CTC) given the ocular symptom but Clinical follow-up showed recurrence of audiovestibular symptoms after dose reduction of prednisone in 4 patients. In these cases, immunosuppressive therapy was able to improve hearing in 3 cases and visual function in 2 cases. Overall, 5 patients maintained good visual; 2 patients did not respond to medical treatment and thus were candidates for corneal transplant, 1 patient presented a total right deafness 3 years after the onset.

**Conclusion:** Cogan's syndrome is a rare autoimmune vasculitis. Although it is the prototype immune-mediated inner ear disease, the variability of ocular and audiovestibular clinical manifestations complicates its diagnosis, which should be suspected whenever there is a close temporal association between ocular abnormalities and cochleovestibular symptoms. The treatment strategies are not clearly defined; therefore, early assessment and treatment for systemic inflammation are needed to prevent life threatening complications.

## **VESTIBULAR DISORDERS IN PATIENTS, SUFFERING FROM METABOLIC DISEASES**

**M.Milkov\*(1)**

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**Systemic metabolic diseases lead to disorders of the function of the inner ear.**

**Sometimes the hearing loss and the vestibular disorders are some of the first clinical signs, mentioned by the patients, suffering from these diseases.**

**Metabolic derangements may produce vestibular symptoms primary or interfere with the compensatory mechanisms of a preexisting vestibular dysfunction. The activity of the cells, including the cells of the labyrinth, is influenced by the hormones and neurotransmitters as they:**

**stimulate or inhibit the metabolic activity of the cellular membrane;**

**regulate the enzyme activity; act directly upon genes.**

**The study was performed at the ENT clinic in the Medical Institute and was approved by the Local Ethic Committee.**

**All patients were interviewed and written informed consent was obtained.**

**The patients passed precise otorhino-laryngological and neurotological examination, including pure tone audiometry and posturography**

**Material and Methods: The study included 340 patients of either gender aged between 35 and 57 years. The patients were with different metabolic diseases such as:**

**hyperthyroidism;**

**hypothyroidism;**

**diabetes mellitus;**

**hyperlipidemia**

**The mechanism of the damages of the organism in patients with hypothyroidism includes:**

**decrease and delay of the oxygen related processes;**

**decrease in the energy production;**

**restriction of the heat production;**

**oppression of the lipolysis and lipogenesis.**

**The mechanism of the damages of the organism in patients with diabetes mellitus includes:**

**hypoxia of the cells of the inner ear;**

**change of the glucose level in the cells in the labyrinth;**

**demyelination of the nerves.**

**The disorders of the auditory and vestibular systems are differently manifested in patients with different metabolic diseases.**

**Sometimes the hearing loss or the dizziness and the unsteadiness are the first mentioned symptoms of the patients, suffering from hormone or metabolic disbalance. We recommend neurotological and endocrinologic examination and treatment of patients with hearing loss and vestibular disorders, suffering from metabolic diseases.**



**EQ-C-37**

## **VESTIBULAR MIGRAINE, ANALYSES OF THIRTY CASES**

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### **VESTIBULAR MIGRAINE, ANALYSES OF THIRTY CASES**

#### **MIGRAINE VESTIBULAIRE, A PROPOS DE 30 CAS**

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**I.Riahi, M.BenSalah**

**Service ORL de l'hôpital Charles Nicolle**

#### **Objective**

In many reports that have documented vertigo and migraine, there is a strong association between vestibular and migraine disorders. The term vestibular migraine appeared in the third edition of the international classification of Headache Disorders/Barany society (IHS, 2012) as a first step for new entities. The aim of this study is to analyses diagnostic criteria for VM and the effect of treatment prophylaxis.

#### **Methods**

Retrospective study was conducted in the period from July 2015 to June 2016. The purpose of medical consultation was Dizziness. Patients fulfilling criteria of definite VM according to IHS were selected. Full neuro-otologic evaluation and videonystagmographic with bithermal caloric testing were included in their files and were analysed.

#### **Results**

The study group had a mean age of 40 years (ranges 10 years - 63 years). There was a predominance of women. Sixty three percent of patients had a history of migraine during 8 months to 10 years. Vertigo was isolated in over 83% of patients or combined with the sense of imbalance in 7% of patients. The sense of bilateral ear fullness and tinnitus was found in 30% of patients. Participants of this study had an attack of Dizziness associated with migraine in 60% of patients. Neuro-otologic evaluation was found normal in all patients. Patients was included into two groups according to HIS (2012), those with certain migraine in 64%, and other with probably migraine in 36%. Positional nystagmus was frequently recorded in 43% of patients. Downbeat nystagmus revealed by Head Shaking test was found in 33% of patients. Caloric weakness was seldom seen (17 % of patients). None of the patients demonstrated abnormalities in ocular motor tests. Audiometric configuration was done in all patients, with normal results. Nearly half of the patients have made magnetic resonance imaging, without abnormalities. Over 85% of patients showed improvement for both symptoms vertigo and headache with prophylaxis treatment as anti-migraine background therapy in both groups of patients.

#### **Conclusion**

A temporal overlap between vestibular symptoms, such as vertigo, and migraine symptoms, such as headache, is a requisite diagnostic criterion. The challenge nowadays is to better

## Vestibular system in primary hypertension

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The purpose of this output is, among hypertensive individuals, to: determine if it is vestibular or central etiology of symptoms, decide which of the vestibular laboratory tests is the best for diagnosis, estimate the correlation between retinopathy degree and vestibular dysfunction and compare vestibular dysfunction and hearing loss. There were two groups in this project. The first one consisted of 104 individuals with primary hypertension, the median time of illness 19 years and mean value of blood pressure 138/91 mm Hg. The second group consisted of 21 healthy persons with average blood pressure above  $\geq 120/80$  mm Hg. There were three groups of laboratory tests. The first one included vestibulo-ocular and visuo-vestibular tests. The second one consisted of audiological tests. The third one consisted of ophthalmoscopy examination of fundus of the eye. There was 86,5% of hypertensive patients who suffered from vestibular dysfunction. It was also found that majority of them – 52,9% had mixed: vestibular and central etiology of symptoms. There was none correlation between retinopathy and the level of damage in the vestibular system. There was also none correlation between degree of retinopathy according to Scheie classification and vestibulospinal reflex tests', VEMPs and stabilometry, with exception of vbody/vhead index. When one compared individuals with or without retinopathy there were none statistically differences in each vestibular laboratory test. There was only one dependence: the majority of retinopathy patients were these with mixed etiology of symptoms. The most significant differences, when comparing two groups: first with vestibular disorders and second with none vestibular disorders were found in somatosensory potentials, craniocorpography, stabilometry, positional nystagmus test and canal paresis  $<0,001$ . The most suitable vestibular laboratory tests in vestibular dysfunction diagnosis among hypertensy patients were: examination of somatosensory potentials, craniocorpography and stabilometry:  $p=0,009$ ;  $p<0,01$ ;  $p=0,0327$ . When one took into account tests connected with vestibulo-ocular and visuo-vestibular reflexes there was none usefulness, besides positional nystagmus test  $p<0,05$ .

When one took into account hearing tests' and vestibular laboratory tests' results it could be seen that in every type of vestibular dysfunction cochlear origin of hearing loss was present  $p<0.0001$ . The hearing loss was found in 95,2% of all individuals and the most useful tests were: otoacoustic emissions, tonal audiometry and brainstem evoked response audiometry.

The most useful vestibular laboratory tests were: vestibulospinal reflexes' tests and somatosensory potentials' tests. The authors recognized mainly cochlear etiology of hearing loss among hypertensive patients with vestibular disorders.

## **The Third Window Syndrome: Case report presenting all three possible Semicircular Canal dehiscence variants.**

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**Superior Semicircular Canal Dehiscence (SSCD) is a well-established entity including conductive hearing loss (CHL), vertigo (Tullio phenomenon) and oscillopsia induced by loud sounds or by Valsalva and Muller maneuvers. At the origin of these symptoms Minor first reported in 1998 the presence of a third vestibular window resulting from a bony defect of the cochlear structure. Thus results in an energy loss, which from the oval window is shunted away to the abnormal third window altering acoustic wave's transmission through perilymph to the round window. By this mechanism less acoustic energy will be available to stimulate the hair cells and a so call "inner ear conduction hearing loss" will be then present. Abnormal dissipated energy toward the third window will generate a perilymph flow which may stimulate vestibular receptors if auditory stimulus is strength enough and then generating a Tullio phenomenon.**

**Later, Merchant and Rosowski (2008) proposed a universal theory for the underlying mechanism of hearing loss accompanying these defects of the bony structure of the inner ear. According to this theory a number of disparate disorders affecting the labyrinth will constantly produce CHL and vertigo by acting as a pathologic third window in the inner ear.**

**As recently reported, the intensity of symptoms was found to be well correlated with the dehiscent surface area.**

**The purpose of this presentation is to stress that 3rd window syndrome is a neurotological condition with different clinical features related not only by area of the dehiscence but also to the anatomical position of the dehiscent SCC in the petrous bone. Although Tullio phenomenon and oscillopsia are constantly present in all variants, CHL is absent in case of dehiscence on the lateral Semicircular Canal or minimal in case of the SCC presentation due to the superior venous sinus. Pulsatile tinnitus amplified by physical effort is constantly found in vertical variants (anterior and/or posterior) but absent in case of lateral SCC dehiscence.**

**EQ-CR-01**

### **3D model of posterior membranous labyrinth from in vivo MRI of human temporal bone, including sensory zones**

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**Objective:** To create a 3D finite element model of the human posterior membranous labyrinth, based on in vivo inner ear magnetic resonance imagery. This model would have a pedagogical interest, and a clinical interest for BPPV and analysis of other types of positional nystagmus.

**Material and methods:**

We used the MRI 3 Tesla acquired in vivo of a human inner with vestibular schwannoma in which the labyrinth geometry is conserved. In this context the elevation of the perilymphatic protide level enables to differentiate the endolymph from the perilymph, and the geometry is well conserved in about 70% of the cases. The 3D reconstruction of the posterior membranous labyrinth was performed through manual segmentation of the endolymphatic and sensory spaces. A surface and volume mesh, with compartmentalization of the different structures was realized. The position of sensory zones was precisely placed based on a radio-histological correlation study.

**Results :** The 3D model includes 132630 finite elements and 27935 nodes. Dimensions are in favor of the validity of the model geometry, comparable to those found in the literature.

**Conclusion:** We present the first 3D model of the posterior labyrinth which uses reconstruction of in vivo images, and specifies the position of all the sensory zones. This model of the posterior membranous labyrinth has the specificity of being morphologically accurate.

**Authors**

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## Development of Mobile Virtual Reality System for Investigation of Subjective Visual Vertical

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**OBJECTIVE:** The aim of the study was to develop a mobile virtual reality based system to perform Subjective Visual Vertical (SVV) test.

**METHODS:** In this study, a mobile virtual reality based system to perform SVV test was developed. During examination the patient uses mobile virtual reality application in order to observe stimulus. The virtual reality environment is controlled by the patient using a Bluetooth connected controllers - Myo gesture control armband or Gamepad. The physician uses another mobile device and software application. The two mobile applications use Bluetooth connection in order to exchange the commands and data. The data can be saved to local database or optionally send to the web server. Four tests were implemented in our system: static SVV test, two dynamic SVV tests and “realistic” („boat in the sea“) SVV test. The group of 15 healthy young adult volunteers participated in the study. There were three objectives of the experiment: to compare three different methods for object control - using Myo gesture controlled armband, Myo gesture controlled armband and the assistant help or Gamepad, to evaluate the developed system with the help of System Usability Scale (SUS) questionnaire, to evaluate possible virtually induced dizziness with the help of visual analog scale.

**RESULTS:** There were no statistically significant differences found among the methods for object control in virtual scenes, SVV values did not exceed 2.5 degrees. Gamepad based control system, evaluated by SUS, is statistically significantly the best for the users. The mean of virtual reality induced dizziness was 2.2.

**CONCLUSIONS:** The mobile virtual reality based system for implementation of subjective visual vertical test is accurate and applicable in the clinical environment. Gamepad based virtual object control method is preferred by the users. No virtually induced dizziness was observed in healthy subjects during the tests.

## **Virtual Reality for Vestibular and Motion Sickness Rehabilitation**

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**L'arrivée sur le marché Grand Public des masques d'immersion en Réalité Virtuelle constitue une véritable révolution dans de nombreux domaines.**

**Les explorations comme la rééducation vestibulaire imposent de nombreuses contraintes d'installation : Pièce parfaitement noire, un outil différent par examen, sacrifice d'une pièce pour l'Optocinétique, Verticale Visuelle Subjective difficile dans des conditions idéales, Rod And Frame Test très éloigné du modèle originel, la Mesure de la Dépendance Visuelle nécessite une plate-forme encombrante et au coût parfois prohibitif, etc...**

**La Réalité Virtuelle permet de s'affranchir de la quasi-totalité de ces contraintes en offrant des mesures précises, des stimulations très « puissantes », de nouveaux paramètres, des conditions d'examen idéales dans n'importe quelle pièce du cabinet/service, de nombreux outils intégrés dans un seul appareil et une nouvelle approche dans le traitement des cinétoses.**

**Les possibilités offertes par cette innovation majeure unique au monde sont actuellement les suivantes :**

- Stimulations Optocinétiques : vection incomparable avec les outils traditionnels, environnements 3D réalistes et variés, en pleine lumière, sans contraintes**
- Stimulations par Flux optique 3D : Nouveau type de traitement des syndromes du défilement**
- Simulations de conduite sur autoroute avec volant/pédales pour traiter le syndrome de l'autoroute de manière innovante et efficace**
- Un outil complet pour le traitement des Cinétoses avec de nombreux conflits sensoriels recréés de manière réaliste et multisensorielle (son, mouvement, vision etc...)**
- Mesures de la VVS, VVS dynamique et Rod and Frame Test en pleine lumière et avec un Rod and Frame Test 3D plus proche de l'outil originel. Le tout avec indication de la position de tête du patient durant les mesures, une précision au 10ème de degré et des protocoles paramétrables à volonté**
- Mesures de la dépendance visuelle avec une cabine virtuelle asservie à la vision (type Equitest® ou CTSIB)**

**De nombreuses équipes de recherche participent activement au développement de ces nouvelles technologies et sont déjà utilisateurs pour leurs travaux : Pr Alain Berthoz (Collège de France), Pr Philippe Perrin (Université de Lorraine-Laboratoire d'analyse du mouvement), Pr Dominique Perennou (CHU Grenoble), Stem Cell and Brain Research Institute (INSERM Lyon), Dr Stéphane Besnard (INSERM Caen), Dr Catherine de Waele (CNRS), Pr Isabelle Bonan (CHU Rennes),**

**L'avenir est en marche grâce à ces nouvelles technologies et elles sont maintenant appliquées aux examens et à la rééducation vestibulaire.**

## **TRANSIENT APPLICATION OF DIFFERENTIAL PRESSURE BETWEEN ENDOLYMPH AND PERILYMPH MIMICKS AN ATTACK OF MENIERE'S DISEASE**

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**Background:** Endolymphatic hydrops is widely seen as a hallmark of Menière's disease. However, it can hardly be thought of as the causative factor of an attack, e.g., as imaging techniques reveal the presence of hydrops in asymptomatic ears. Hydrops, meaning volume inflation, may be a long-lasting result of past bouts of hydrostatic imbalance between compartments but tells nothing about ongoing hydrostatic pressure. We posited that an acute pressure difference between endolymph and perilymph, by acting on the geometry of cochleo-vestibular organs, might modify the operating point of hair cells and induce fluctuating hearing loss, increased electrocochleographic SP/AP and vestibular dysfunction.

**Material and Methods:** Anesthetized Mongolian gerbils were equipped with an intracranial canula allowing pressure manipulations of labyrinthine fluids via the cerebrospinal fluid (CSF). With an intact bony labyrinth, pilot experiments have shown that when CSF pressure is increased (0 to 50 mm water in 10 mn steps), little happens apart from an elevation in stiffness of the middle-to-inner ear boundary at the oval window. Next, we created a perilymphatic fistula near the oval window, in the hope that when CSF pressure would again increase, whereas the same pressure increase would occur in the endolymph, perilymph would leak through the fistula with a pressure difference between endolymph and perilymph as a result. Otoacoustic emissions (OAEs) and electrocochleography were monitored, allowing auditory thresholds and SP/AP to be measured. The presence of spontaneous nystagmus was analyzed.

**Results:** In the presence of perilymphatic fistula, within seconds after CSF pressure increase, SP/AP started to increase up to more than 100%, lower-frequency AP thresholds increased by 30 dB or more and the phase of low-frequency OAEs shifted as expected if the operating points of outer hair cells were displaced. A spontaneous nystagmus appeared. It took several minutes for the whole picture to complete and about 30 minutes to 2 hours to disappear after CSF pressure was brought back to normal.

**Discussion and Conclusion:** Many typical features of an attack of Menière's disease, fluctuating hearing loss, vestibular signs, increased SP/AP, OAE phase shifts, not only their size but also their time course, are reproduced by the creation of differential pressure between endolymph and perilymph, which we propose as an essential causative factor of the attack. Whatever would naturally cause such a pressure difference in one ear would trigger an attack.

**EQ-CR-05**

## **A novel animal model for Meniere's disease**

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**Purpose:** Meniere's disease (MD) is histologically characterized by endolymphatic hydrops (EH) in the inner ear. EH is considered to be the result of dysfunction of inner ear water homeostasis, which involves excessive production of endolymph and/or reduced absorption of endolymph. Clinical studies suggest that stressful lifestyle and a stress modulating hormone, vasopressin (VP), correlate with disorder of the inner ear homeostasis. In the present study, we examined morphological and functional changes in our novel animal MD model, involving the surgical obliteration of the ES and the administration of VP.

**Materials and Methods:** Guinea pigs used in morphological studies underwent surgical obliteration of the ES in the left ear and maintained for 1 or 4 weeks, and divided into groups with or without desmopressin (VP type 2 receptor agonist; V2 agonist) administration. We quantitatively assessed EH in the cochlea, vestibules and semicircular canal. We recorded spontaneous nystagmus and observed the presence or absence of balance disorder in the normal control group, desmopressin administration group and surgically treated groups with (combined) or without (surgical) desmopressin administration.

**Result:** Both the increase ratio of the scala media area and the proportion of the endolymphatic space in the saccule were significantly higher in the combined group than in the surgical group. There were no significant differences in the degree of hydrops in the utricle or semicircular canal among the ear groups. all animals of the combined group showed spontaneous nystagmus and balance disorder; whereas the surgical group was asymptomatic.

**Conclusion:** Our experimental animals not only presented severe EH in the cochlea and the saccule, but also showed balance disorders and nystagmus. EH may be exacerbated due to ES dysfunction and the effects of desmopressin; acute V2 phenomenon, which may accompany vestibular abnormalities that are similar to vertigo attack in MD patients.



## **Intratympanic isosorbide reduces endolymphatic hydrops (EH) and ameliorated audiovestibular function in the guinea pigs**

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**Purpose of the study:** The fluctuating nature of Meniere's disease (MD) was related to the volume change of endolymphatic hydrops (EH) and reduction of EH ameliorated MD. Diuretics were frequently prescribed to treat MD for their ability to reduce EH through diuresis. Isosorbide was an osmotic diuretic as a frequent therapy to treat hydrocephalus and glaucoma. Systemic isosorbide was also frequently used to treat MD with good results. However, systemic diuretics may be contraindicated in MD patients with cardiac or renal problems. On the contrary, local delivery of isosorbide in the ear could be a better option since it avoids systemic side effect and achieves higher local concentration in the inner ear than systemic administration. This study aimed to verify the effectiveness and drawback of locally-delivered isosorbide on the EH in the inner ear.

**Materials and methods:** Endolymphatic hydrops were surgically induced in the right ear of male albino guinea pigs. Auditory and vestibular function tests including ABR, cVEMP, oVEMP were performed before and 2 weeks after surgery. Isosorbide solution 0.15mL (700 mg/mL) was then administered intratympanically in the right ear of the guinea pigs after audiovestibular tests were complete. The same audiovestibular tests were repeated again 6 hr and 24hr after isosorbide administration on the same animals. Temporal bone sections were obtained after above procedures.

**Results:** Endolymphatic hydrops were successfully induced in the right ear of guinea pigs. Impairment of audiovestibular function was noted in the hydropic ears including elevation of hearing thresholds, reduction or absence of cVEMP and oVEMP waveforms. Response rate of cVEMP and oVEMP also decreased. Auditory and vestibular function was significantly improved as measured by ABR, cVEMP and oVEMP by intratympanic isosorbide, either 6 hr or 24 hr after administration. Lowering of hearing threshold by intratympanic isosorbide can be up to 15-20 dB in the hydropic ear. Reduction of response rate of cVEMP and oVEMP by EH was ameliorated after intratympanic isosorbide administration. Morphologically, cochlear and vestibular hydrops were also reduced by intratympanic isosorbide in the section of cochleae, vestibule and semicircular canals.

**Conclusion:** In the ear with surgically-induced hydrops, locally-delivered isosorbide through intratympanic approach did not cause ototoxicity; on the contrary, it ameliorated the auditory and vestibular dysfunction caused by EH in the guinea pigs. This new therapeutic approach avoids side effect of systemic isosorbide and can be as effective to reduce EH. Its clinical usefulness can be expected for the MD patients.

**EQ-CR-07**

**Degeneration of the vestibular nerve in Meniere's disease evaluated by vestibular-evoked myogenic potentials**

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**Purpose of the study:** To evaluate the vestibular function in patients with unilateral Meniere's disease using vestibular-evoked myogenic potentials (VEMP).

**Materials and methods used:** Seventy patients with unilateral Meniere's disease were enrolled in this study. Within 2 weeks of the disease onset, all subjects underwent cervical and ocular VEMP tests, evoked by air-conducted sound (ACS), bone-conducted vibration (BCV), and galvanic vestibular stimulation (GVS). The prevalence of individual abnormal test and the characteristic parameters (including amplitude and latencies) of VEMP tests were further analyzed.

**Results:** In affected ears, the abnormal rate of ACS-cVEMPs was significantly higher than that of GVS-cVEMP (37% v.s. 17%). Similar with the results of cVEMP testing, the abnormal rate of BCV-oVEMPs was significantly higher than that of GVS-oVEMP (20% v.s. 9%) in affected ears. No significant differences existed in the characteristic parameters between affected ears and unaffected ears. The stage of Meniere's disease, abnormal GVS-cVEMP response and abnormal GVS-oVEMP response had significant positive correlations with the disease duration

**Conclusion:** The impairment of otolithic organs was found to be more than that of vestibular afferents. Degeneration of the vestibular nerve seems to be secondary to damage of otolithic organs. Patients with abnormal GVS-VEMP responses may reflect with longer disease duration.

## **Hearing and vestibular disorder in children and young adults with Friedreich ataxia.**

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### **1 Purpose of the study**

**Friedreich ataxia (FA) is the most common of inherited ataxias. Clinical features of the disease include progressive limb and trunk ataxia, cardiomyopathy, scoliosis, and an increased rate of diabetes mellitus.**

**Some studies on FA individuals reported oculomotor disorders and impairment of vestibular and auditory functions. The aim of the present study is to evaluate the prevalence of these impairments in a large group of children and young adults with genetically confirmed FA.**

### **2 Materials and methods**

**Forty-two subjects with diagnosed FA (18 boys and 24 girls) aged from 7 to 24 years old were tested (27/42 <18y). The diagnosis of FA was established for all after a complete checkup in a pediatric department and genetical testing. Oculomotor, vestibular and hearing evaluations were performed. The complete hearing assessment included impedance measurement, audiometry, transient evoked otoacoustic emissions, hearing test and auditory brainstem response (ABR). The oculomotricity assessment included the evaluation of gaze stability, saccades, smooth pursuit and optokinetic nystagmus. The vestibular evaluation included several tests investigating canal and otolith functions.**

### **3 Results**

**All subjects have normal or near to normal hearing threshold. However, 49% have abnormal ABR.**

**Gaze instability is found in 70% of the patients (28/40) and is characterized by the presence of squared waves jerks (28/28) and less frequently flutter (8/28). Abnormal hypermetric saccades are observed in 75% (30/40) and saccadic pursuit in 55% (22/40).**

**Vestibular function is also partially impaired. Low velocities canal responses to bicaloric test are relatively preserved with 91% of normal responses. However, high velocities canal responses (evaluated with head impulse test) are impaired in 50% of the patients. Otolithic function is severely affected in this population. Only 8% and 3% have normal cervical vestibular evoked myogenic potential with, respectively, air conducted and bone conducted stimuli.**

### **4 Conclusion**

**To our knowledge this is the largest group of children and young adults with confirmed FA ever examined with complete auditory and vestibular batteries of tests. Our results show evidence of auditory neuropathy which implies that children with FA likely face communication and educational challenge. Moreover, FA is characterized by severe and widespread oculomotor and vestibular impairment, which can, in association with the ataxia, have a strong negative impact on their autonomy. The high prevalence of these oculomotor and vestibular disorders could be used to help differentiate FA from other spinocerebellar ataxias and monitor their evolution.**

## EQ-CR-11

### VHIT for kids

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**Objectives :** Video Head Impulse Test (VHIT) is a new tool to investigate semi-circular canals function, at high frequencies (5 Hz), easy to use with pediatric population. Caloric testings quantify lateral semi-circular canal function at very low frequencies (0,002-0,004 Hz). The aim of this study was to evaluate the correlation between the gain of vestibulo-ocular reflex (VOR) measured with VHIT and results of caloric testings in pediatric population.

**Methods :** Children aged 1-14 years who underwent lateral canal VHIT and caloric stimulation have been included in this retrospective monocentric study. VHIT was registered with a standalone camera set in front of the patient (Synapsis System), calculating the gain of vestibulo-ocular reflex (VOR) ; then, caloric stimulation was performed (water or air), nystagmus were recorded using video-nystagmography. A VOR gain below 0,7 was considered abnormal ; a nystagmus below 5°/s (slow-phase velocity at the culmination phase) at caloric stimulation defined vestibular hypofunction.

**Results :** 30 children were included, the average age was 5,4 years. Over 32 consultations, 4 were emergencies, others were scheduled. 18 consultations were pre-cochlear implantation, hearing loss, congenital cytomegalovirus infection, developmental delay assessment ; 14 were for vertigo and dizziness evaluation. Over 64 ears, 7 (10,9%) VHIT had VOR gain below 0,7, 7 (10,9%) had a caloric response below 5°/s. In 6 ears (9,3%, 4 (12,5%) consultations over 32), results were discordant : half had a VOR gain below 0,7 and caloric response over 5°/s, the other half had a VOR gain over 0,7 and caloric response below 5°/s. VHIT sensitivity compared to caloric stimulation is 57%, specificity is 94%.

**Conclusion :** In our practice, VHIT is a reliable test for pediatric vestibular assessment, mainly for screening ; our results confirm that it cannot replace rotatory chair and caloric testing in assessing vestibular function, particularly before cochlear implantation. When medical history and vestibular clinical examination of a vertigo do not evoke a vestibular cause, normal VHIT allows the otolaryngologist to stop investigations.

## **Intra- and inter-examiner reliability of two separate video Head Impulse Test systems assessing all six semicircular canals**

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**Purpose of the study:** The video Head Impulse Test (v-HIT) is currently recommended as the initial test when evaluating vestibular function. The v-HIT is considered to be an objective test despite the fact that it is both technical demanding to carry out and also relies upon subjective processing and interpretation of results after the test is completed. The purpose of this study was to evaluate both intra- and inter-examiner reliability of v-HIT testing when assessing all six semicircular canals (SCCs) of two separate v-HIT systems.

**Materials and methods used:** 80 subjects with no previous vestibular or neurological disorders were tested. Subjects underwent four separate tests of all six SCCs with either EyeSeeCam® from Interacoustics or ICS Impulse® from GN Otometrics. All subjects were tested twice by a senior doctor having several years of experience with performing v-HIT testing and twice by a medical student with no previous experience. Pre-test randomization included type of system, order of paired SCC testing as well as initial examiner.

**Results:** Limits of agreement (LOA) were calculated for both intra- and inter-examiner reliability. Coefficients (CC) were calculated for inter-examiner reliability. EyeSeeCam®: Intra-examiner LOA from 0.13 to 0.28 for the horizontal SCCs and 0.42 to 0.77 for the vertical SCCs. Inter-examiner LOA were 0.15 and 0.21 for the horizontal SCCs and varied from 0.44 to 0.54 for the vertical SCCs. ICS Impulse®: Intra-examiner LOA from 0.11 to 0.13 for the horizontal SCCs and 0.13 to 0.22 for the vertical SCCs. Inter-examiner LOA were 0.16 for both horizontal SCCs and varied from 0.12 to 0.22 for the vertical SCCs. Most SCC mean differences were close to zero with both v-HIT systems. CCs showed a similar pattern as the LOAs. Bland-Altman plots and bi-variate plots were calculated.

**Conclusion:** Both v-HIT systems displayed low intra- and inter-examiner variability with horizontal SCC testing. With vertical SCC testing ICS Impulse® displayed good intra- and inter-examiner reliability whereas the opposite was true with EyeSeeCam®.

**Clinical applicability:** Both v-HIT systems were found applicable for testing of the horizontal SCCs. However, with vertical SCC testing, only ICS Impulse® was found to provide reliable and reproducible results. Finally some level of experience is beneficial when performing the v-HIT test.

The abovementioned results are based on preliminary results. A presentation at the ENT World Congress Paris 2017 will include updated results and conclusions based on v-HIT testing of 120 subjects in total.

**EQ-CR-13**

## **Video Head Impulse Test in children: normative data and test-retest reliability**

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### **Video Head Impulse Test in children : normative data and test-retest reliability**

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#### **Abstract**

VHIT is a new vestibular test which allows evaluation of the six semicircular canals at high frequencies. VHIT is usually described as a quick and easy test in children as it does not induce nausea or dizziness and does not require darkness.

The aim of this work is to obtain vestibulo-ocular reflex gain normative data and assess the test-retest reliability in a pediatric population.

#### **Methods**

20 children aged 4-15 years with a normal clinical vestibular evaluation and no history of vestibular or neurological disorders have been included in this prospective study. Horizontal vestibulo-ocular reflex at high frequencies has been assessed using a Synapsis Evolution II vHIT device. Eye movements during passive head rotations in the horizontal plane are detected with a high-speed digital video camera and no goggles are placed on the head. The testing has been repeated for all the subjects after thirty minutes to investigate the test-retest reliability.

#### **Results**

A great majority of the children has completed the test. Our first results show a mean vestibulo-ocular reflex gain value for the horizontal semicircular canal between 0,9 and 1. No significant difference can be found between the two sessions of measures. At this time, the study is still in progress and more precise results will be available shortly.

#### **Conclusion**

VHIT is easily performed in children and usually well tolerated in contrast to caloric testing. Our first vestibulo-ocular reflex gain measures for the horizontal semicircular canal differ only slightly from results found in young healthy adults.

## **Vestibular evoked myogenic potentials in patients of large vestibular aqueduct syndrome**

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**Objective:** To explore the characteristic of vestibular evoked myogenic potentials (VEMPs) in patients with large vestibular aqueduct syndrome (LVAS).

**Methods:** 23 children under 12 years old with bilaterally LVAS were enrolled in the case group. 12 healthy individuals adjusted with age and sex were involved as controls. Ocular-VEMP (oVEMP) and cervical-VEMP (cVEMP) were recorded in bilateral ears.

**Results:** oVEMP was elicited in 43 among 46 affected ears of LVAS patients (93.48 %), and in all of 24 healthy controlled ears (100 %). Significant difference was not found in response rate between the affected ears and the healthy controls ( $P>0.05$ ). Mean elicited thresholds and amplitudes of oVEMP were  $85.58 \pm 5.14$ ,  $13.54 \pm 12.31$  in LVAS group and  $85.63 \pm 5.17$ ,  $8.79 \pm 5.70$  in control group. Mean latency of N1, P1, P1-N1 intervals of oVEMPs were  $9.98 \pm 1.47$ ,  $14.01 \pm 1.46$ ,  $4.46 \pm 1.04$  in affected ears, and  $9.86 \pm 0.61$ ,  $14.37 \pm 1.06$ ,  $4.51 \pm 1.07$  in controls, respectively. No significance of the parameters was found between the LVAS group and control group. cVEMP was elicited in 40 among 46 affected ears of LVAS patients (86.96%), and in all of healthy controls (100%). Significant difference was found in response rate between the affected ears and the healthy controls ( $P<0.05$ ). Mean elicited thresholds and amplitudes of cVEMP were  $80.75 \pm 7.29$ ,  $344.57 \pm 210.33$  in LVAS group and  $80.83 \pm 5.24$ ,  $379.84 \pm 178.68$  in control group. Mean latency of N1, P1, N1-P1 intervals of cVEMP were  $20.94 \pm 2.47$ ,  $14.60 \pm 1.86$ ,  $6.72 \pm 1.51$  in affected ears, and  $21.68 \pm 1.33$ ,  $15.05 \pm 0.96$ ,  $6.62 \pm 0.92$  in controls, respectively. No significance in tested parameters was found between the two groups.

**Conclusions:** Abnormal response rate of cVEMP in LVAS patients refer to certain lesions on the vestibular pathway. Application of VEMPs in LVAS patients contributes to the diagnosis of the disease.

**EQ-CR-15**

**round table- modern vestibular testing**

**M.Střiteská\*(1)**

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I'm an ENT doctor , I'm working with the modern instrumental vestibular testing that includes VHIT, VOG, VEMPs just one year, but almost daily, focusing on vestibular disorders for years.

I'd like to discuss in more otoneurologist doctors from ENT to share experiences . I would like to discuss also about the pitfalls in doing new instrumental vestibular testing, because on the beginning of practising with new vestibular equipment, we had many... Also can discuss about management of vestibular testing - bedside and instrumental examining ... when just performing the bedside examination is sufficient and when instrumentál examination is needed ...

also about testing the vestibular system in multiple-frequency range.

also discuss what kind of new information from the new vestibular testing can we achieve. How it can be very usefull in diferencial diagnosing periferal from central vestibular lesions. Also that we can gain informations about the course of vestibular dysfunction in time , that we can measure improvement during the therapy, also can see the effect of vestibular rehabilitation, also can see the level of vestibular compensation.

If there are any question, please contact me : [mstriteska@seznam.cz](mailto:mstriteska@seznam.cz)

MUDr. Maja Striteska, ENT department Faculty Hospital Charles University in Hradec Králové



**EQ-CT-01**

## **EVALUATION OF AUDIO-VESTIBULAR TESTS IN MENIERE DISEASE AND VESTIBULAR MIGRAINE**

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**JONATHAN ESTEBAN-SANCHEZ , RICARDO SANZ-FERNANDEZ, EDUARDO MARTIN-SANZ**  
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### **OBJETIVE**

Differential diagnosis between Meniere disease (MD) and vestibular migraine (VM) could be a challenge , specially in the early presentation. This study aim to analyse the accucacy of most common audiovestibular test in these two clinical pictures.

### **METHODS**

This is a retrospective study with a total of 106 patients, divided in two cohorts with the following inclusion criteria:

- **First cohort:** Those patients with an initial diagnosis of unilateral definite MD according to diagnostic criteria proposed by the Barany Society International Classification for Vestibular Disorders Committee
- **Second cohort:** Those patients with an initial diagnosis of definite VM, with aural symptoms localised by the patient, according to the consensus document of the Barany Society and the International Headache Society.

No other medical evidence or suspicion of central nervous system involvement with the exception of migraine

All patients underwent a complete neuro-otological examination, audiometry, cervical and ocular VEMPs and an extratympanic electrocochleography.

### **RESULTS**

Of the 106 patients included, 56 patients were diagnosed of Meniere disease and 50 of vestibular migraine.

Auditory differences were observed between both groups, with higher thresholds in every frequency analyzed in the Meniere disease group

Comparison of cervical and ocular VEMPs amplitudes and latencies in Meniere disease patients with the vestibular migraine group revealed no statistical differences for either side.

The mean SP/AP amplitude ratio for affected ears was significantly higher ( $p=0.002$ ) in those patients with Meniere disease compared to the vestibular migraine patients. When the unaffected ear was compared, no statistical differences were observed in both groups ( $p=0.503$ ).

### **CONCLUSIONS**

Results in audiometry and VEMPs do not help us to make a difference between patients with Meniere disease and vestibular migraine.

**Results in extratympanic electrocochleography show a greater SP/AP ratio in affected ear of Meniere disease patients compared with vestibular migraine patients.**

**Vestibular migraine/Meniere's disease overlapping syndrome: consideration of its pathophysiology from the viewpoint of clinical findings**

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**Vestibular migraine/Meniere's disease overlapping syndrome: Consideration of its pathophysiology**

**Toshihisa Murofushi, Masahito Tsubota, Ryota Suizu, Eriko Yoshimura**

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**[Purpose]** Recently, diagnostic criteria of vestibular migraine and Meniere's disease has been published by Barany Society (2012, 2015). Both diseases are common, and diagnosis is easy in typical cases. However, clinicians sometimes encounter patients whose episodes of vertigo contain features of both diseases. Such patients may be diagnosed with having vestibular migraine/Meniere's disease overlapping syndrome (VM/MD OS). We present patients who should be diagnosed with VM/MD OS and discuss its pathophysiology based on neurophysiological findings such as vestibular evoked myogenic potentials (VEMP) and medical history.

**[Subjects and Methods]** Patients with recurrent episodic vertigo who fulfilled the following criteria were enrolled.

**Inclusion criteria**

- A.** At least 5 episodes with vestibular symptoms of moderate or severe intensity lasting 20 min to 24 hours.
- B.** Current or previous history of migraine with or without aura according to the International Classification of Headache Disorders (ICHD).
- C.** One or more migraine features with at least 50% of the vestibular episodes.
- D.** Audiometrically documented low to medium frequency sensorineural hearing loss in one ear, defining the affected ear on at least one occasion before, during or after one of the episodes of vertigo
- E.** Fluctuating aural symptoms (hearing, tinnitus or fullness) in the affected ear.
- F.** Not better accounted for by other vestibular diagnoses than VM, MD or their overlapping syndrome.

**Clinical findings of enrolled patients including vestibular evoked myogenic potentials (VEMP) were studied.**

**[Results]** One of prominent features of these patients was that they showed tuning property shifts of cervical vestibular evoked myogenic potentials (cVEMP), which is suggestive of endolymphatic hydrops. Their audio-vestibular symptoms were preceded by general migraineous symptoms.

**[Discussion and Conclusion]** Results in this study suggested that patients with VM/MD OS might have EH secondary to migraine.

## **Videonystagmography (VNG) test positional protocol for patients with vestibular migraine**

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**Vestibular migraine is an episodic vertigo syndrome. It is one of the most common vestibular disorders affecting up to 1% of the general population and 11% of patients in specialized dizziness clinics.**

**Similar to migraine itself, the diagnosis of vestibular migraine is made on the basis of the patient's history and the exclusion of other causes.**

**Vestibular migraine can present different vestibular symptoms with ou without autonomic symptoms. Patient can experience spontaneous vertigo, positional vertigo, or head-motion dizziness in isolation or in any combination. However, the pathophysiology has been unclear.**

**The aim of this study is to record and describe the spectrum of oculographic findings in vestibular migraine whith the videonystagmography test protocol for positional vertigo.**

### **Materials and Methods;**

**This study selected patients that fulfilled the diagnostic criteria of the consensus document of the Bárány Society and the Internacional Headache Society of 2012. Eye movements were recorded in darkness under videonystagmography in following head positions (test protocol for positional vertigo diagnose): sitting with the head upright, sitting with chin-to-chest position, lying, lying with the left and right ear down.**

### **Results:**

**Eleven patients with vestibular migraine were evaluated under VNG Test protocol for positional vertigo. Two were male and nine were female. None of them were in an acute episode of headache but all of them complained about vestibular symptoms. Two did not present nystagmus during the test. Two had vertical spontaneous nystagmus and positional nystagmus combined. Nine presented positional nystagmus with central characteristics. All of patients had negative results in magnetic resonance imaging (MRI).**

### **Conclusion**

**Vestibular migraine is a common and a clinically heterogeneous disorder. Its diagnose can be very difficult and challenging. In this study we found pathological nystagmus in 81% of the patients. The test protocol for positional vertigo with VNG can be very helpful during the investigation and the follow up of these patients.**

**Efficacy of DIAMOX on preserving auditory thresholds in patients with long term Ménière's disease: a monocentric retrospective cohort study**

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**Introduction:** Ménière's disease evolution leads to severe unilateral or bilateral hearing loss in most of the patients. Specific treatments, whether they are conservative or not, mainly focus on addressing vestibular symptoms and acute vertigo crisis. There is no recent study to discuss audition preservation or to propose an effective treatment to prevent or delay hearing loss after long term evolution of the disease.

**Objective:** The goal of our study is to measure the objective impact of long term treatment with DIAMOX, a potassium-depleting diuretic, on the auditory threshold of patients with definite Ménière's disease.

**Methods:** We conducted a retrospective monocentric cohort study on 600 patients presenting with definite Ménière's disease between 2000 and 2014. All patients had a follow up time of at least 3 years during the course of evolution of the disease. There were 401 patients treated with optimal dose of DIAMOX. Patients who previously had a radical treatment were excluded. All patients had an initial pure tone audiometry before starting DIAMOX and at the end of the follow up period. Drug intolerance and adverse effects were reported. The control group was composed of patients who presented a contraindication to DIAMOX or who had a disease under control with other medical treatments.

**Results:** We analyzed results for 128 patients with DIAMOX and 77 patients without. The two groups were comparable for age and sex. The initial auditory threshold was worse in the group treated with DIAMOX (-49dB vs. -35dB on average). The mean follow-up duration was 8 years. All patients presented with a significant mean auditory impairment of 30dB HL (mean threshold at the end of follow-up= -65dB HL). When treated with DIAMOX, 10% of the population had a stable auditory threshold at the end of follow-up period and 56% presented a significant improvement of 3dB HL on average (mean threshold at the end of follow-up= -46dB HL). There was a statistical difference between the two groups. DIAMOX was well tolerated (17% of minor adverse effects).

**Conclusion:** We showed a significant difference in auditory threshold when comparing patients who received DIAMOX with patients without it. It is possible to improve or at least prevent hearing loss progression with early treatment with DIAMOX after diagnostic. Further studies are needed to address the impact on the audition quality of delayed treatment with DIAMOX and evaluate the combined approach that associates DIAMOX and MANNITOL when assessing symptomatic Ménière's disease.

**EQ-CT-05**

## **Management options and results in 251 patients with Meniere's disease: Asan Medical Center experience**

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The treatment in Ménière's disease patients to medical treatment remains a challenge. Oral preventive medication is a mainstay in managing MD patients and intratympanic gentamicin stands as a good alternative in the management of refractory vertigo patients followed by chemically ablating the vestibular function. Due to the ototoxic effect of gentamicin on hearing as well as vestibular function, low-dose intratympanic gentamicin therapy is gaining popularity with successful control of the symptoms of Ménière's disease, while preserving hearing. Anatomic barriers to the round window membrane (adhesions, bone dust blocking the round window, or a thickened round window membrane) may be a significant cause of intratympanic gentamicin failure, and middle ear exploration with direct application of gentamicin to the round window can be considered before further ablative therapy.

Intratympanic steroid perfusion is also reported to control vertigo, though less effectively than intratympanic gentamicin, and improve functional activity in intractable Ménière's disease patients with good hearing preservation. Intratympanic (IT) dexamethasone can allow a large percentage of intractable Ménière's disease patients to avoid ablative therapies. In our experience, 80% of 251 patients with MD had symptomatic improvement with medications only and 18% needed intratympanic steroid and/or gentamicin injections, and only 5% needed surgical interventions, including explotympanotomy with direct gentamicine application to round window and vestibular neurectomy. Indications for each treatment modalities and results are discussed.

## **How to identify vestibular paroxysmia and discriminate it from vestibular migraine**

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**Introduction:** Vestibular paroxysmia (VP) is a syndrome defined by short vertiginous spells and the presence of a microvascular compression of the eighth cranial nerve. Patients with VP experience short lasting vertigo spells of the order of seconds to minutes, often triggered by specific body positions. The symptoms can occur daily several times. At first sight, VP generates symptoms that overlap considerably with vestibular migraine (VM). Vestibular migraine is the most common cause of vertigo in patients visiting the ENT or neurology clinic, while VP is less common, but more . Yet, an early identification of vestibular paroxysmia and discrimination from vestibular migraine would allow to treat the patient appropriately in an earlier stage. The aim of this retrospective tertiary referral center study was to identify key variables derived from history taking (SO STONED), clinical examination, audiovestibular testing and imaging techniques, to facilitate the clinical diagnosis of VP as well as discrimination from VM. We included 38 VP patients who presented with vertigo episodes, a microvascular compression of the eighth cranial nerve on MRI and improvement of symptoms by treatment with carbamazepine or oxcarbazepine. Additionally, 38 VM patients were included, based on the published criteria and confirmed by symptom alleviation after vestibular migraine medication intake.

**Results:** Dizziness was significantly less present in VP (55%) than in VM (79%) (Chisq  $p=0.028$ ) but occurred significantly more daily in VP (74%) than in VM (50%) ( $p=0.034$ ). Whole body movement triggered significantly more symptoms in VP (65%) than in VM (40%) ( $p=0.028$ ). Visual disturbances triggered more symptoms in the VM group (55%) than in the VP group (19%) ( $p=0.001$ ). Photophobia: VM (81%) and VP (34%) ( $p<0.001$ ). Symptoms lasting seconds to minutes in VP (66%) while VM (39%) ( $p=0.0022$ ). We observed during the Dix Hallpike maneuver in 84% of the VP patients a non-BPPV type nystagmus, i.e. not a clockwise or counterclockwise with crescendo-diminuendo pattern, whereas we noted in 40% of the VM patients a non-BPPV type nystagmus ( $p<0.001$ ).

Combining several variables in one index (like the BMI), we constructed by means of statistical logistic regression methods a VPVM index that helps to discriminate VP patients with 85% certainty and VM patients with 88%.

## **The role of Magnetic Resonance Imaging in the diagnosis of endolymphatic hydrops and Menière's disease**

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### **Purpose**

A dedicated 3T magnetic resonance imaging (MRI) protocol of the inner ear was introduced to evaluate the presence and extent of endolymphatic hydrops (EH). In this pilot study, we assessed retrospectively the sensitivity and specificity of this MRI protocol in patients diagnosed with definite Menière's disease (MD) according to the new diagnostic criteria.

### **Material and methods**

The study was performed on a 3-Tesla MRI machine using a three-dimensional-fluid-attenuated inversion recovery (3D-FLAIR) sequence performed 4 hours after an intravenous (iv) injection of a double dose of gadolinium. EH in the cochlea and/or vestibule was classified as either none, grade I or grade II (cfr. reported criteria in recent literature). Thirteen patients diagnosed with unilateral definite MD were included (mean age was 53,8 years). For ethical reasons (potential long-term side effects of gadolinium administration) no control group (healthy volunteers) could be included. Therefore, contralateral healthy ears (normal hearing level, normal caloric response and present cVEMP response) of the included patient population were used as normal control ears.

### **Results**

The MRI was positive in 10 out of 13 definite MD suspected ears, resulting in a sensitivity of 77%. The MRI was negative in each (n = 13) of the healthy ears, leading to a specificity of 100%.

### **Conclusions**

This preliminary study confirms that 3T 3D-FLAIR MRI of the membranous labyrinth performed 4 hours after iv gadolinium administration can be a very helpful tool for diagnosing definite MD. Further studies in a larger patient population will be required to confirm these preliminary findings.



## **Meniere's disease: Respective contributions of Audio-Vestibular Functional Tests and Inner Ear MRI**

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### **Objectives**

Meniere's disease is a rare inner ear disorder generally attributed to an endolymphatic hydrops. Different electrophysiological tests and imaging techniques have been developed to improve endolymphatic hydrops diagnosis.

The goal of our study was to compare the sensitivity of delayed inner ear magnetic resonance imaging (MRI) after intravenous injection of gadolinium with extratympanic clicks electrocochleography (EcochG), phase shift of distortion product otoacoustic emission (phase shift OAEs) and vestibular evoked myogenic potentials (VEMP) for the diagnosis of Meniere's disease.

### **Materials and Methods**

41 patients were included prospectively from april 2015 to april 2016 in our institution. Patients included had definite or possible Meniere's disease based on the latest AAO-HNS guidelines. All patients go through delayed inner MRI after intravenous injection of gadolinium (3D-FLAIR sequence), pure-tone audiometry, extratympanic clicks EcochG, phase shift OAEs and VEMP on the same day. Endolymphatic hydrops was graded on MRI using the saccule to utricule ratio inversion (SURI) defined as when the saccule appeared equal or larger than the utricule.

### **Results**

Abnormal EcochG and phase shift OAEs were found in 68% and 64.5%, respectively, of patients with definite Meniere's disease (DMD). The two methods were significantly associated in DMD group. In DMD group, 25.7% had a positive MRI nevertheless the association between MRI versus EcochG and phase shift OAEs was not significant and detection of hydrops by MRI was dependant of hearing loss. Finally, 22.9% of DMD group had positive VEMP.

### **Conclusion**

EcochG and phase shift OAEs are reliable ways of diagnosing Meniere's disease. Inner ear MRI could be useful in case of hearing loss over 35 dB.

## **Electrocochleography in Ménière's disease**

**E.Martin-sanz<sup>†</sup>(1)**

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Since the initial description of Ménière's disease (MD) in 1861 the disorder has been defined and redefined on several occasions.

The pathophysiology of MD is not completely understood. Nadol et al. reported that endolymphatic hydrops should be considered as histologic marker rather than being directly responsible for the symptoms of MD.

Many studies suggest that the displacement of the basilar membrane toward the scala tympani results in an increase in the summating potential. Functional testing, including the use of electrocochleography (EcoHG), has been used to identify hydrops.

As with all aspects of Ménière's disease, the EcoHG measurements tend to fluctuate considerably during the course of the disease and are more likely to be abnormal during symptomatic periods of the disease. Nevertheless, such variability makes it difficult to establish a link between the grade of hydrops and the effect of a particular treatment, such as the use of intratympanic steroids.

It has been noted a considerable variability in the absolute values of SP, both in normal subjects and in patients with MD. That's the reason why in the medical literature, the relationship between EcoHG measurements and treatment outcomes remains controversial. Normalizing the SP amplitude to the AP amplitude (SP/AP ratio) has been found to be useful in decreasing the intersubject variability.

In our experience, extratympanic EcoHG is a useful tool not only for diagnosis but for monitoring certain treatments such as intratympanic steroids. Bilateral MD or those cases of unclear diagnosis, specially in the first years after onset of the symptoms are a few examples of clinical scenario where the EcoHG may be particularly helpful.

**Ménière's disease: pathogenesis and natural history**

**G.Morrison\*(1)**

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**Author: Gavin Morrison, Consultant in Neuro-Otology, Guy's & St Thomas' NHS Foundation Trust, London**

**Prosper Ménière first described the disease 156 years ago, yet remarkably little is fully understood about its pathogenesis. The condition continues to cause great suffering and disability, and presents an exceptional challenge to its long-term management.**

**The condition's pathogenesis is reviewed, and the long-term results and natural history of a personal series of 124 patients with Ménière's disease is presented.**

**Historically, studies were at a macroscopic and histological level, and focussed on patterns of longitudinal endolymph flow. Now, ion transport mechanisms and aquaporins have been investigated at a molecular level. There are known associations with migraine and auto-immunity, and genetic factors are being investigated. Despite this, the aetiology and exact pathophysiologies remain elusive.**

**124 patients with Ménière's were followed clinically over 18 years. Based on history, up to 40 years of follow-up was available. 20.9% had bilateral disease during the study period. The interval between the onset of disease in the first and second ears is reviewed. The second ear can become involved as late as 18 years after the first. Vertigo typically occurs in clusters of severe attacks over a 6-8 week period before the disease becomes more quiescent, explaining why all treatments administered during a bad spell appear beneficial. Frequency and severity diminishes after 11 years but can continue. Burnout occurs between 10 and 18 years following the onset in the age range 50 – 87.**

## **Evaluation of vestibular neurectomy efficacy and safety for disabling Meniere's disease and Tumarkin's syndrome : a retrospective study of 149 patients**

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### **Introduction**

Parmi les patients porteurs d'une maladie de Ménière (MM), seuls 10% environ évoluent vers une forme invalidante. Ils sont sévèrement invalidés à la fois par la fréquence des crises vertigineuses et l'intensité des symptômes neurovégétatifs qui les accompagnent, ou par l'évolution vers un syndrome de Tumarkin, générateur de blessures, voire de graves accidents, suite à la perte brutale de leur tonus postural. Des traitements radicaux supprimant la fonction vestibulaire sont alors nécessaires. L'objectif est de définir l'efficacité et la sécurité de la neurectomie vestibulaire (NV) chez ces patients.

### **Matériels et méthodes**

Etude rétrospective, monocentrique réalisée au centre hospitalo-universitaire de Reims de janvier 2003 à juillet 2016 chez des patients majeurs atteints d'une MM invalidante et/ou compliquée d'un syndrome de Tumarkin, ayant bénéficié d'une NV par voie rétrosigmoïde. Le diagnostic de MM probable ou définie reposait sur l'évaluation clinique des patients (critères AAO-HNS 2015). Le caractère invalidant et les seuils auditifs pré/post-opératoires ont été déterminés à partir des critères de l'AAO-HNS 1995. L'efficacité thérapeutique, définie par une disparition totale des vertiges et des chutes, les complications post-opératoires et la variation des seuils auditifs (variation des Pure Tone Average -PTA- pré et post opératoires analysée avec le t de Student apparié) sont déterminées au cours des consultations de suivi des patients.

### **Résultats**

149 patients (âge moyen : 52,36 ans [22-75]) dont 52,34% d'hommes, présentant une MM invalidante (grade  $\geq 4$  sur l'échelle d'invalidité de l'AAO-HNS : 69,13%) et/ou un syndrome de Tumarkin (30,87%), ont bénéficié d'une NV. L'efficacité totale postopératoire est observée chez 97,67 % des patients revus à 1 an (n=85), 95,92% à 3 ans (n=49), 93,33% à 5 ans (n=30) et 100% à 10 ans (n=10). Aucun décès per ou postopératoire n'est rapporté et les complications sévères sont de l'ordre de 3,36% (n=1 rhinorhée, n=2 méningites tardives, n=1 embolie pulmonaire massive et n=1 infection cicatricielle nécessitant une hospitalisation). La variation des PTA pré et postopératoires n'est pas statistiquement significative (n=120, moyenne = +0.54 dB, IC95 [-1.65 ; 2.73], p=0,625).

### **Conclusion**

La NV est un traitement chirurgical radical dont le risque, y compris auditif, est faible au regard de l'efficacité quasi-totale du geste sur le contrôle à court, moyen, long terme des vertiges. Ce traitement peut donc être proposé dans les cas sévèrement invalidants et les syndromes de Tumarkin.

**EQ-CT-12**

**The significance of prophylactic migraine therapy in controlling Familial Meniere's Disease, A Preliminary Study**

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• **Abstract**

**Objective:** To investigate the effect of prophylactic migraine therapy in controlling vertigo episode of Meniere's Disease.

**Method:** We prospectively collected 16 cases of Familial Meniere' Disease (FMD) diagnosed in our Vertigo Outpatient from November 2012 to June 2014. Divide into WithOut Migraine group(WOM) and With Migraine group(WM). Give WM group a prophylactic therapy for migraine and compare between groups about the follow-up results of vertigo episodes.

**Results:** In our research, 5 of the total 16 patients have migraine which morbidity (31%)is similar with European's, and is higher than the migraine morbidity in total Chinese population (2%~24.35%) . WOM group had better results in controlling vertigo. The remission effect equaled after we added a prophylactic therapy for migraine.

**Conclusion:** We are the first research of FMD in Chinese population and the clinical signs of the patients are similar. Combined with prophylactic migraine therapy may have better effect in accompanying migraine patients when controlling Familial Meniere's Disease. But we are only a preliminary study so we need to collect more further. Moreover, we also plan to observe the effect of prophylactic therapy for with migraine group.

• **Authors:**

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**THE DIZZY PATIENT: FOUR BY FOUR APPROACH TO INTERVENTION**

**A.Alamadi\*(1)**

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**OBJECTIVE:** To present a systematic approach to the practical management of the dizzy patient in the office setting. This approach is based on the experience from the Multidisciplinary Neurotology Clinic of the University Health Network, Toronto General Hospital.

**MAIN MESSAGE:** The dizzy patient presents challenges in a busy clinic even for an experienced physician. Having a consistent systematic approach will minimize the time required to reach a most probable diagnosis so that further investigations can be directed appropriately. With a carefully directed history and by following our four by four approach we have found that in > 90 % of the dizzy patients the cause can be confidently diagnosed. The distinction between dizziness and the true vertigo can be made by allowing the patient time to describe their feelings in their own words. Patients with true vertigo have vestibular pathology which can be peripheral or central in origin. Peripheral vestibular disorders are often associated with other inner ear symptoms such as hearing loss, tinnitus and aural fullness. Patients with central vestibular disorders are more likely to have complaints of focal neurological dysfunction, for example diplopia, dysphagia, parasthesia or paresis. Clinical examination of a dizzy patient should include a relevant otological and neurological examination.

**CONCLUSION:** By following our four by four method physicians can diagnose majority of the dizzy patients. Special vestibular tests and diagnostic manoeuvres are valuable and easy skills to learn for assessment of the dizzy patient.

## **EQ-CT-14**

### **Treatment of inner ear disorders during pregnancy**

**P.Wu\*(1)**

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#### **Purpose of the study:**

This study reviewed our experience in the treatment of inner ear disorders during pregnancy.

#### **Materials and methods used:**

We experienced a total of 68 pregnant women with inner ear disorders from 1995 to 2014. We performed audiometry and caloric test to all the patients. We added cervical vestibular-evoked myogenic potential (cVEMP) test after 2000 and ocular VEMP (oVEMP) test after 2008 to the test battery.

#### **Results:**

The percentages of inner ear function deficits in pregnant women showed a significant declining sequence from abnormal cVEMP test (44%) to abnormal oVEMP test (21%), abnormal mean hearing level (13%), and abnormal caloric test (12%). In all the 68 patients, we have diagnosed vestibular migraine in 34 patients (50%), followed by sudden deafness in 14 (21%), autonomic nervous system disorder in 10 (15%), peripheral vertigo in 6 (9%), Meniere's disease in 3 (4%), and one patient (1%) with vestibular schwannoma.

#### **Conclusion:**

Vestibular migraine and sudden deafness attributed to more than 70% of the pregnant women with inner ear disorders, and audiometry helps differentiate between the two diseases. cVEMP test had the highest abnormality of the inner ear test battery in pregnant women, likely because half of the patients were vestibular migraine, which has been correlated with abnormal cVEMPs.

## **Superior Canal Dehiscence Syndrome: Suspicion, Diagnosis and Treatment**

**I.Saliba\*(1)**

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**Superior Canal Dehiscence Syndrome (SCDS) was reported by Minor in 1998. There is an absence of the bone coverage of the canal.**

**Patients with SCD have cochlear and / or vestibular symptoms.**

**They are suffering from hyperacusis, autophonia, ear fullness, pulsatile tinnitus, oscillopsia, tulio phenomenon and disequilibrium.**

**Hearing test shows a low frequency air-bone gap and a negative bone conduction at the lower frequencies.**

**cVEMP (cervical vestibular evoked myogenic potential) and oVEMP (ocular VEMP) threshold are below normal level.**

**Bilateral Simultaneous Caloric Test (BSCT) shows that even though we obliterate the canal, its vestibular function remains about 30%.**

**Video head impulse test (vHIT) is now considered a part of our battery of tests permitting to evaluate the function of the three semicircular canals in the operated ear, where the VOR gain and the covert and overt saccades are analyzed.**

**The symptoms are explained by the theory of the 3rd window created by the superior canal dehiscence and affecting the endolymph of the inner ear, giving the cochlear and vestibular symptoms.**

**Presentation objectives:**

- 1) Discuss the assumptions behind the etiology of SCS.**
- 2) Report symptoms and management of SDS.**
- 3) Present the radiological tools to diagnose the SCS.**
- 4) Report cochlear and vestibular pre and postoperative data.**
- 5) Present details of the middle fossa approach for superior canal plugging.**



## **FACTEURS PSYCHOLOGIQUES PREDICTIFS DE LA RECUPERATION POSTURALE A COURT, MOYEN ET LONG TERMES APRES CHIRURGIE DU SCHWANNOME VESTIBULAIRE**

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### **FACTEURS PSYCHOLOGIQUES PREDICTIFS DE LA RECUPERATION POSTURALE A COURT, MOYEN ET LONG TERMES APRES CHIRURGIE DU SCHWANNOME VESTIBULAIRE**

**OBJECTIFS:** identifier les facteurs psychologiques (traits de personnalité, représentations de la maladie et stratégies de coping) susceptibles de faciliter ou freiner la récupération posturale après chirurgie du SV.

**METHODES:** Dix-neuf patients, ayant un schwannome vestibulaire, dont l'indication chirurgicale a été posée, ont passé des tests de posturographie, des tests vestibulaires et ont rempli des questionnaires psychologiques, trois jours avant la chirurgie, huit jours, un mois, trois mois et un an après la chirurgie.

Les évaluations ont été réalisées avec le Sensory Organization Test, une vidéonystagmographie, l'inventaire révisé de personnalité (NEO PI-R), le questionnaire révisé des représentations de la maladie (IPQ-R) et le Brief-COPE. Les analyses statistiques ont été menées grâce une technique de modélisation d'équations structurelles (Partial Least Square Structural Equation Modeling PLS-SEM) afin d'identifier les facteurs psychologiques prédictifs des scores de posturographie un mois, trois mois et un an après la chirurgie.

**RESULTATS** l'anxiété, l'altruisme-sensibilité et l'ouverture à ses sentiments et émotions sont les facettes de personnalité prédictives de la récupération posturale qui influencent les représentations de la maladie et les stratégies de coping, avant et après la chirurgie.

Les conséquences quotidiennes, la façon dont est perçu le caractère curatif de la chirurgie pour le SV (Chronologie, Cycle et Contrôle du Traitement) et la charge émotionnelle sont les représentations de la maladie prédictives de la récupération posturale postopératoire qui influencent les stratégies de coping, avant et après la chirurgie.

La non-acceptation et le déni, un faible recours à l'humour, à la réinterprétation positive et au coping actif et un évitement par le recours à des activités qui détournent l'attention du processus thérapeutique peuvent freiner la récupération posturale à court, moyen et long termes.

**CONCLUSIONS** les professionnels de santé doivent être attentifs aux manifestations suivantes, avant et après la chirurgie : des conséquences importantes du SV sur le quotidien, une forte anxiété, des manifestations émotionnelles qui perdurent, des difficultés à prendre soin de soi, des hésitations concernant le choix de la chirurgie comme solution thérapeutique pour le SV, la non-acceptation de la situation et une tendance à l'évitement du processus thérapeutique. L'identification de ces facteurs de vulnérabilité devrait permettre d'orienter les patients vers une prise en charge psychologique, avant et/ou après la chirurgie.

## **Vertige révélant une malformation d'Arnold Chiari type 1**

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(2)CHU Hassan II Fes, Fes, Morocco

### **Objet de la présentation :**

**La malformation de Chiari de type 1 correspond probablement à une anomalie congénitale, qui se traduit par une position basse des amygdales cérébelleuses. Le but de notre travail est de rapporter la démarche diagnostic devant un syndrome vestibulaire central menant à diagnostiquer une malformation d'Arnold Chiari de type 1.**

### **MATÉRIEL ET MÉTHODE :**

**Analyse descriptive d'un cas clinique souffrant de cette malformation, de son tableau clinique, de la démarche diagnostic.**

### **RÉSULTATS :**

**Homme de 52 ans, sans antécédents, présente un syndrome vestibulaire central, nécessitant la réalisation d'une VNG qui a montrée des signes de centralités (tests d'oculomotricités anormaux), un bilan radiologique (IRM) objective une malformation d'Arnold Chiari type 1.**

### **CONCLUSION :**

**La malformation de Chiari 1 est fréquente. À la différence des malformations de Chiari de type 2 et 3, elle peut être longtemps latente, reconnue seulement chez l'adulte. Cependant, depuis le développement de l'imagerie par résonance magnétique, il n'est pas rare qu'elle soit découverte dès l'enfance. Elle est évoquée devant des vertiges, des oscillopsies ou des troubles de l'équilibre survenant dans un tableau de souffrance bulbo-protubérantielle.**

### **Auteurs:**

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## **Test de Vibration Osseux Vestibulaire (TVOV)-Atelier**

**G.Dumas\*(1), S.Schmerber(2)**

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**Introduction.** Une vibration appliquée par voie osseuse à 100 Hz sur la mastoïde induit instantanément un nystagmus à composante prédominante horizontale, battant du côté sain chez des patients qui ont une lésion unilatérale vestibulaire (LUV). La même stimulation chez des sujets sains asymptomatiques n'a aucun ou peu d'effet. Ceci constitue le Nystagmus induit par vibration crânienne (NIVc) et c'est un indicateur utile, simple, non invasif, robuste d'une asymétrie de la fonction vestibulaire et du côté du déficit. Le nystagmus est précisément lié au stimulus: il démarre avec la stimulation et s'arrête à la fin de celle-ci, sans inversion secondaire. Il reste soutenu pendant de longues périodes de stimulation; il est reproductible; il bat toujours dans la même direction quelle que soit la mastoïde stimulée; il montre peu ou pas d'habituation; il est définitif – Même des patients LUV anciens bien compensés présentent un NIVc.

**Moyens et Méthodes.** Un NIVc peut être observé sous lunettes de Frenzel ou en videonystagmoscopie et enregistré sous videonystagmographie en l'absence de fixation visuelle ou de fort traitement sédatif.

**Résultats.** La fréquence du stimulus, sa topographie et l'intensité sont susceptibles de modifier les résultats et une grande variabilité de la morphologie crânienne entre individus peut modifier le stimulus. Cependant le NIVc obtenu à 100 Hz par stimulation mastoïdienne constitue une réponse robuste. Cette présentation décrit les modalités de stimulation optimale sur les bases des données de la littérature et notre propre expérience actuellement de plus de 19500 patients.

Des découvertes physiologiques récentes ont permis d'établir quels étaient les récepteurs vestibulaires stimulés, comment le nystagmus était induit, pourquoi une même vibration chez des patients avec déhiscence du canal semi-circulaire antérieur (DCA) entraînait un nystagmus battant du côté de l'oreille pathologique.

Cette présentation s'attachera à montrer les paramètres du stimulus et des réponses chez des patient LUV ou avec DCA mais décrira également comment d'autres pathologies vestibulaires affectent ou modifient le NIVc (Schwannomes vestibulaires, Névrites, Maladie de Menière, Labyrinthectomies chimiques).

En conclusion la présence d'un NIV est un indicateur utile d'une asymétrie vestibulaire entre les 2 oreilles, mais afin d'identifier laquelle est concernée d'autres informations et une appréciation clinique complète et prudente sont nécessaires.

**EQ-FR-04**

## **PRISE EN CHARGE CHIRURGICALE DES VERTIGES INVALIDANTS**

Y.Rous\*(1), I.Rous(2), S.Djamal(3)

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### **SURGICAL COVERAGE(CARE) OF THE INVALIDATING DIZZINESSES**

I.Rous

Sid Ahmed

Bendimerad

Y Rous

**Introduction?** This study concerns the coverage(care) of the invalidating peripheral dizzinesses.

**? Exluant the dizziness symtome organic affections**

**Objectives?** To Analyze the efficiency on the dizziness and the impact on the hearing(audition)? Objective common of these traaitements is the obtension of a déafférentaaation vestibulaire

**Problem:**

**? The result(profit) paar principle, been born has to not entrainer of additional aftereffects notaammeent on the function(office) auditivee and leee facial nerve**

**Materials(Equipments) and Method?** Retrospective carrying(wearing) Study on 23N.v and of 07 L.C (realized between 2010 in 2016).

**? The vestibulaires results(profits) were objectified by calorie tests(events) before treatment(processing) and 06 months after treatment(processing).**

**? The subjective success was estimated by the scale(ladder) EEV.**

**? A tonal audiometry was realized before the treatment(processing)**

**CONCLUSION?** N.v offers a better control of the vertgies quela L.C which however stays an effective method of the treatment(processing) of the invalidating dizzinesses.

**? Whatever is the used method, the quality of the result(profit) depends on the degree of destruction vestibulaire obtained.**

**? The hearing results(profits): the average loss is de10 in 20db.**

**Comparison of the results(profits) of two étudesNV Strong Hypovaleence (> 90 %) EEV Degradation of the hearing Thresholds**

**Our study ( 23 cases) ( 2010-2016 ) 82,6% 91,3% 30,4ù**

**Study Nmorel ( 71 cases) ( 1997-2003 ) 90% 93% not significant**

**LC Forte Hypovaleence > 9 %) EEV Degradation of the hearing thresholds**

**Our study ( 7 cases) ( 2010-2016 ) 71,5 % 85,7 % 42,9 %**

**Study N. Morel ( 35 cases) ( 1997-2003 ) 86 % 81% not significant**

**EQ-I-01**

## **Cochlear implantation and simultaneous labyrinthectomy in Meniere's disease**

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### **INTRODUCTION:**

Active Meniere's disease may be both invalidating for his vertigo spells, fluctuating vestibular function with unsteadiness, hearing loss and tinnitus. The patients suffering unilateral Meniere's disease may present with normal hearing or with sensorineural hearing loss in the non affected ear. In the last case hearing can be very poor. Bilateral cases of Meniere's disease may be more challenging. Medical management and intratympanic therapies allow us to cure with efficacy most of the cases; conservative surgical therapy as endolymphatic sac surgery or surgical vestibular ablation with gentamicine or vestibular neurectomy permit a better control of vertigo but may fail to control ear pressure and tinnitus with their fluctuations. In selected cases with poor hearing, a single surgery with simultaneous labyrinthectomy and cochlear implantation may provide a cure of the main Meniere's symptoms and a hearing rehabilitation of the same ear.

**OBJECTIVE:** To see the efficacy of the procedure on the control of MD symptoms and provide hearing rehabilitation in 5 patients.

**METHODS:** in the period 2013-2016, five patients with MD have been selected for simultaneous labyrinthectomy and cochlear implantation. The reason was incapacitating vertigo or disequilibrium not responsive at previous medical and surgical treatments ranging from intratympanic gentamicine to endolymphatic sac surgery with unaidable hearing in the same ear.

**RESULTS:** All the patients have experienced a complete control of the vertigo attacks and a better equilibrium. One old female patient suffering frequent falls got a great improvement. The hearing was better for all patients for two main reasons: the absence of any disturbance from the implanted ear in noisy environments and the gain in hearing provided by the implant. The efficacy of the implant in providing hearing rehabilitation was of course better in the patients with contralateral sensorineural hearing loss.

**CONCLUSIONS:** simultaneous labyrinthectomy and cochlear implantation provided an excellent result in the treatment of selected patients with invalidating Meniere's disease vestibular symptoms and poor hearing.

## **Simultaneous Cochlear Implantation and Cochleosacculotomy for Patients with Progressive Menière's Disease**

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**Purpose of the study:** In progressive Menière's disease, patients are commonly experiencing profound deafness in the affected ear, which is no longer eligible for speech understanding even with powerful hearing aids. While the affected labyrinth of the same ear shows deficits, its residual function can still induce vertigo attacks that are bothersome and can be disabling. For those patients, ablative interventions in order to shut down the affected labyrinth provide a potential solution. We investigated the feasibility of simultaneous cochlear implantation (CI) and cochleosacculotomy in terms of post-operative vestibular function and hearing restoration.

**Patients and methods:** From May 2013 until November 2016, 26 patients (18 male, 8 female) underwent cochleosacculotomy for the affected ear in progressive Menière's disease. The procedure was performed as described by Schuknecht in 1982 using a round window approach. The round window provided access for simultaneous cochlear implantation in 20 patients. We compared pure tone audiometry and speech audiometry data pre- and postoperatively (with CI) and compared those with subjective hearing restoration, while including vestibular function tests pre- and postoperatively.

**Results:** Pre-operative pure tone audiometry, averaged over 0.5, 1, 2 and 4 kHz, ranged between 61.25 and 112.5 dB for the affected ear. Post-operatively, CI threshold levels ranged between 23.75 and 41.25 dB. Maximum intelligibility for monosyllables ranged pre-operatively between 0 and 90% at 85 to 120 dB, while post-operatively, results were obtained between 20 and 90% at 75 to 85 dB. Post-operatively, 2 patients still had prolonged spontaneous nystagmus as recorded by video-oculography under infrared illumination. In 9 cases, vestibular evoked myogenic potentials were still elicited in cervical or ocular recording or in both.

**Conclusion:** Simultaneous cochlear implantation and cochleosacculotomy is a feasible and rational treatment modality in patients with a long-standing history of unilateral Menière's disease, when conservative treatment options have failed and hearing on the affected side is no longer sustained with conventional hearing aids.

## **The influence of cochlear implantation PDT-EAS (partial deafness treatment-electroacoustic stimulation) on vestibular function**

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**PURPOSE OF THE STUDY:** Vestibular and balance disorders are one of the common complaints among the patients after cochlear implantation. Thanks to hearing preserving methods like RWA (round window approach), soft electrodes, various insertion depth of the electrode and postoperative steroids administration, the indications for cochlear implantation have been broadened and included patients with partial deafness. One of the surgical methods for cochlear implantation of patients with low-frequency residual hearing is PDT-EAS (partial deafness treatment – electro-acoustic stimulation). The aim of the study is to assess vestibular status and vestibular symptoms before and after PDT-EAS cochlear implantation and to determine whether hearing preservation techniques protect the vestibulum as well.

**MATERIALS AND METHODS:** The patients who underwent PDT-EAS cochlear implantation and the prospective analysis of their vestibular status. In each case cVEMP, oVEMP, VNG, vHIT and SOT examination were performed before, 1-3months and 6-9months after the operation. The assessment was completed by fulfilling the questionnaire describing vestibular symptoms. In VEMP responses the latencies, corrected amplitude and ratio of post- to preoperative amplitude were measured. In VNG slow phase velocity, directional preponderance and unilateral weakness were assessed.

**RESULTS:** Patients with low-frequency residual hearing achieved better results in preoperative vestibular tests than those with total deafness. After PDT-EAS cochlear implantation vestibular symptoms were rare and transient. No statistically significant difference were noticed in caloric tests and vHIT results comparing them pre- and postoperatively. cVEMP and oVEMP responses were present pre- and postoperatively. However, the corrected amplitude measured postoperatively was decreased.

**CONCLUSIONS:** PDT-EAS cochlear implantation protects the function of vestibular organ. Sacculus and utricle are the most susceptible organs to be influenced by the cochlear implantation.

## **Impact of cochlear implantation on vestibular function in the adult**

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**Purpose:** Cochlear implantation could have a negative effect on vestibular function on the implanted side, just as it does for residual hearing. Our objective is to search for eventual repercussions of cochlear implantation on postoperative subjective symptoms and peripheral vestibular function.

**Material and methods:** Prospective study. From July 2014, all patients undergoing cochlear implantation benefited pre- and postoperatively from a neurovestibular assessment including a questionnaire, and objective clinical tests: head-impulse test (HIT), head-shaking test (HST), skull-vibration test (SVT), caloric tests, and vestibular-evoked myogenic potentials (VEMP). The operative note was analyzed and eventual intraoperative unexpected events were noted. Fisher's t test was used for statistical analysis.

**Results:** 22 patients were included (12F/10M). Mean age 62 years, mean follow-up period 4 months. HIT was abnormal (ipsilateral saccade) preoperatively in 18% of patients and in 59% of patients postoperatively. HST was abnormal (contralateral nystagmus) preoperatively in 1 patient (4.5%) and this remained the same postoperatively. SVT showed an ipsilateral hypofunction (contralateral nystagmus) in 30% of cases preoperatively and in 50% postoperatively. Caloric tests showed significant (>25%) ipsilateral hypofunction in 50% of cases preoperatively and in 58% postoperatively. VEMP were absent in 68% of patients preoperatively and in 86% postoperatively. Regarding subjective symptoms, 50% of patients described a certain degree of dizziness preoperatively and 50% postoperatively. After cochlear implantation, we noted an improvement of dizziness symptoms in 3 patients and a worsening in 4 patients, all elderly (>75 years old). In general, symptoms were not statistically correlated with the obtained results of objective vestibular tests, nor was the surgical technique or type of implant ( $p>0.05$  in both analyses). More patients will be included and presented in this study at the time of e-poster/oral presentation in June 2017.

**Conclusion:** Cochlear implantation is a weak predictor of postoperative vestibular disturbances except for some cases, particularly in elderly patients. Symptoms are not systematically associated with abnormal vestibular tests or surgical events. Implanted patients already have some degree of preoperative alteration of vestibular function, as is the case for hearing function. There were some rare cases of symptom improvement after implantation. Our results are similar to those already published in the literature.

**PS:** The authors would like to kindly ask the Scientific Board to turn this abstract in a short oral presentation. Thank you in advance, we would highly appreciate.



**Effects of unilateral cochlear implantation on balance control and the perception of the environment in adult patients with profound hearing loss.**

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As reported by the World Health Organization, deafness is a public health problem. Indeed, deaf people tend to close up in themselves, reducing their quality of life (Rumeau et al., 2015). The cochlear implantation makes it possible to restore the perception of sounds but also the intelligibility of the speech. However, the inner ear is not strictly devoted to hearing, but also to balance control. Buchman et al. (2004) & Jacot et al. (2009) have attempted to evaluate the consequences of cochlear implantation on the balance control and the vestibular organ. However, conflicting results were reported and studies did not focus on the perceptual component of equilibrium. Indeed, as suggested by the model of Massion (1994), the stability of the system is also assured by the orientation of the body in space and the perception of vertical gravity. Thus, the aim of this study was to describe the evolution of the performances of control balance in a context of multi-sensory stimulation and the evolution of the visual perception of the vertical gravity during the 45 days following the cochlear implantation.

**Methods:** 26 participants took part in the study and were divided into two groups: the implanted group consisting of 16 bilateral deaf participants. Patients were compared to a healthy control group (n = 10). Both groups performed balance assessment (sensory organization test – Equitest®) and perception of the vertical gravity assessment (i.e. replacement of a light rod to the vertical) before implantation (D-3) and twice after (D+3, D+45).

**Results:** We observed lower preoperative balance control scores (mean=65%± 10; D-3) in the implanted group than that of the control group (mean=85%±5 p<0.05). Post-operative postural performance of patients appeared to be slightly altered with a significant increase in vertical perception error (mean=7°±2; p<0.05; D+3) compared to the healthy control. After 45 days, we noted an improvement in postural performance (mean=70%±10) and for the perception error of the vertical compare (mean=1±1) to the second visit.

**Conclusion:** The strong increase in perceptual error before implantation suggests an attack of the otoliths, whose play a fundamental role in the detection of the vertical gravity. Finally, as has been shown by other studies (e.g. schwannoma; Borel et al., 2014 ; Parietti-Winkler et al., 2006), we observed a postural and perceptual compensations at 45 days after surgery follow the schedule of implementation of compensation mechanisms characterized by the use of other sensory afferents and new behavioural strategies.

## **Does the insertion depth of the electrode influence the vestibular function after cochlear implantation?**

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**Purpose of the study:** Application of hearing preservation techniques in partial deafness treatment has significantly diminished the rate of vestibular disorders after cochlear implantation. The aim of the study is to determine whether the insertion depth of the electrode has the impact on vestibular status after the cochlear implantation. The insertion depth of the electrode may correspond with the cochlear trauma, especially in its apical region and consequently with the postoperative vestibular function.

**Methods and materials:** The patients who underwent cochlear implantation procedure were divided into three groups according to the type of implantation and the insertion depth of the electrode: PDT-EC (Partial Deafness Treatment - Electric Complement), PDT-EAS (Partial Deafness Treatment – Electric Acoustic Stimulation), PDT-ES (Partial Deafness Treatment - Electric Stimulation). Each patient was assessed with cVEMP, oVEMP, caloric tests, vHIT and fulfilled the questionnaire concerning vestibular symptoms before and 6-9months after the operation.

**Results:** The hearing preservation techniques protect the function of the vestibulum. Vestibular symptoms after cochlear implantation are mostly transient and in the early postoperative period. The postoperative vestibular tests showed no difference between PDT-EAS and PDT-ES group. cVEMP and oVEMP measured as post- to preoperative corrected amplitude ratio were slightly better preserved in PDT-EC than PDT-EAS and PDT-ES groups.

**Conclusions:** The insertion depth of the electrode has insignificant impact on postoperative vestibular function, apart from slightly better utricular and saccular function after PDT-EC implantation.

## **Vestibular function and cochlear implantation, in pediatric population**

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### **Introduction :**

Des études ont montré les risques de l'implantation cochléaire pour la fonction vestibulaire et l'importance de l'évaluation vestibulaire chez l'enfant avant implantation cochléaire. Cette évaluation chez le jeune enfant est parfois difficile. Néanmoins le VHIT est un nouvel outil permettant d'évaluer le gain du reflexe vestibulo-oculaire, de réalisation plus aisée chez l'enfant. L'objectif de cette étude était d'évaluer la fonction vestibulaire dans une population pédiatrique avant et après implantation cochléaire, et de comparer les résultats du VHIT et de l'épreuve calorique.

### **Méthode :**

Étude rétrospective comprenant 38 enfants, de janvier 2013 à décembre 2016. Consistait à déterminer le statut vestibulaire d'enfants candidats à un implant cochléaire, et d'évaluer leur fonction vestibulaire après implantation. Le bilan comprenait: évaluation clinique, test calorique, cVEMP et VHIT, l'ensemble des tests n'étant pas toujours réalisable chez les jeunes enfants. Le VHIT permet de mesurer le déficit canalaire aux hautes fréquences. Avec le matériel Synapsis, il est réalisable facilement chez l'enfant (grâce au système de caméra déporté), ne nécessitant qu'une fixation de la cible, permettant d'obtenir en moins de 10 minutes une analyse de la fonction canalaire. Nous avons comparé les résultats obtenus au VHIT/calorique.

### **Résultats**

L'âge moyen d'évaluation était de 3,9 ans. Une prévalence élevée de dysfonction vestibulaire (59%) est retrouvée dans le groupe pré-implantation (n = 19) dont 1 aréflexie bilatérale et 3 aréflexies unilatérales. La même prévalence est retrouvée dans le groupe post-implantation avec 63% de dysfonction vestibulaire (n=19, résultats préliminaires). L'analyse des résultats préliminaires fait état d'une aggravation dans 15% des cas de la fonction vestibulaire après implantation. 15/15 oreilles qui présentaient une altération sur le VHIT avaient également une altération sur les réponses caloriques (spécificité de 100%), mais 2/17 oreilles qui avaient un VHIT normal présentaient une altération sur les réponses caloriques (sensibilité de 88%).

### **Conclusion**

Cette étude confirme la prévalence élevée du dysfonctionnement vestibulaire, pouvant être profond compte tenu des 20% d'aréflexie uni/bilatérale retrouvée. L'évaluation vestibulaire est primordiale, avant implantation, permettant de "guider" l'implantation cochléaire (choix du coté, séquentiel ou non en cas d'implantation bilatérale), afin d'éviter une possible aggravation dans les cas de déficits préexistants. La sensibilité du VHIT par rapport à la stimulation calorique est de 88%, et la spécificité de 100% dans cette étude. Le VHIT est un test rapide et fiable pour l'évaluation vestibulaire, mais ne peut pas remplacer l'évaluation complète avant l'implantation cochléaire, la sensibilité de ce test n'étant pas de 100%.

**The effect of cochlear implantation on vestibular function: Objective assessment with vHIT.**

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**Propose:** analyze the effect of cochlear implantation (CI) on vestibular function.

**Introduction:** CI is a safe surgical procedure, but it may cause an adverse effect on vestibular function. Video Head Impulse Test (vHIT) is a new and validated device to evaluate vestibular function in horizontal and vertical semicircular canals (SCC) and to register the VOR gain.

**Material and Methods:** we present a prospective study, where 15 patients with a bilateral severe to profound sensorineural hearing loss, candidates for CI (11 men, 4 women; mean age: 52,2 , range: 11-81) were recruited between January and October of 2016. Unilateral CI was performed in all cases (5 right ear, 10 left ear). Vestibular function was objectively assessed using vHIT, before CI and 4 weeks after CI.

The vHIT test result was considered positive for weakness in the tested SCC when refixation saccades were observed after head impulses in the excitatory direction for that SCC. The gain of VOR was considered positive for weakness in the tested SCC under 0.8.

**Results:** 4 patients presented previous vestibular hypofunction (3 bilateral Menière Disease and 1 meningitis). 11 patients presented normal vestibular function before CI in the implanted ear. After CI, 3 patients with previous normal vestibular function presented overt type refixation saccades in the horizontal canal of the implanted ear in exploration with vHIT.

The VOR mean gain was 1.09 preoperatively and 1.22 postoperatively for head impulse >100°/s and 1.09 preoperatively and 1.04 postoperatively for head impulse >150°/s. In the 3 patients with refixation saccades in the exploration with vHIT, the VOR mean gain decreased from 0.83 to 0.69 (>100°/s) and from 0.96 to 0.67 (>150°/s) in horizontal SCC.

**Discussion/conclusion:** The vHIT objectively demonstrates postoperative vestibular changes in 27,3% of patients with previous normal vestibular function. Although CI is a safe surgery, the risk of vestibular injury has to be taken into account and it is important to inform CI candidates about possible risk to balance function. In conclusion, we consider vestibular assessment with vHIT really useful prior and after CI.

## **Computed Tomography and Magnetic Resonance Imaging-based Finite Element Analysis Predicts Current Flow in Labyrinths Implanted with a Multi-Channel Vestibular Prosthesis**

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**Purpose:** As is true for cochlear implants, current spread beyond the intended target of a given electrode is a key factor determining the pattern of nerve stimulation elicited by a multi-channel vestibular prosthesis. Our goal was to construct a robust, anatomically precise finite element model of current flow in the implanted labyrinth and better understand the biophysics of ampullary, utricular, saccular, cochlear and facial nerves stimulation.

**Materials and Methods:** Model geometry was generated through 3-dimensional (3D) reconstructions of a normal rhesus temporal bone imaged using microMRI data obtained with a 11.7 Tesla Magnet (48  $\mu\text{m}$  isotropic voxels) and microCT (70  $\mu\text{m}$  isotropic voxels ). The extracellular potential field during a biphasic current pulse was computed using finite element methods.

Potential field values then served as inputs to stochastic, nonlinear dynamic models for each of 2,415 vestibular afferent axons with spiking dynamics based on a modified Smith and Goldberg model. A well-validated model of myelinated fibers implemented action potential propagation. Eye rotation 3D axes were predicted from the relative proportion of model axons excited within each of the ampullary nerves and compared to actual 3D angular vestibulo-ocular reflex axes elicited by prosthetic stimuli.

**Results:** The model's predicted axis aligned well with the actual axis of eye rotation, with misalignment of  $18 \pm 6.1$  degrees (mean  $\pm$  SD) for the 234 stimulation conditions examined.

**Conclusion:** Extension of the model to human anatomy should facilitate optimal design of electrode arrays for clinical application.

## Evaluation of vestibular implant performance in humans using the video head impulse test (vHIT)

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### Purpose of the study

The Video Head Impulse Test (vHIT) has become a gold standard in vestibular testing. It allows side specific, independent assessment of the 6 semicircular canals in the high frequency range. vHIT is an optimal test for the evaluation of the performance of vestibular implants, which are devices designed to primarily restore canal function in patients with a bilateral vestibular loss (BVL). This study uses the vHIT to evaluate whether it is possible to restore the high-frequency, angular vestibulo-ocular reflex (aVOR) with a vestibular implant.

### Materials and methods

At the time of writing, two patients with a BVL fitted with a vestibular implant prototype were available for this study. The device consists in a modified cochlear implant (MED-EL, Innsbruck, Austria) where 3 electrodes were taken out of the cochlear array and put in separate branches that were implanted in the ampullae of each semicircular canal. The high-frequency, aVOR was assessed using the vHIT (EyeSeeCam VOG; Munich, Germany) while motion-modulated electrical stimulation was delivered via one of the implanted vestibular electrodes (S1 – lateral ampullary nerve, S2 – superior ampullary nerve). Results obtained with different modulation depths (i.e., different intensities of stimulation for the same stimulus) were compared to control measurements obtained in the patients when the device was not activated.

### Results

The aVOR gain in the plane and direction of the implanted ear increased monotonically with increased modulation depths, reaching a maximum gain of 0.48 (S1 - horizontal) and 0.90 (S2 - RALP) at the largest modulation depth tested. The gains away from the implanted ear were much lower (<0.30). There was a significant positive correlation between aVOR gains and modulation depth (Pearson's linear correlation; S1:  $R^2=0.98$ ,  $p<0.001$ ; S2:  $R^2=0.94$ ,  $p<0.01$ ). Both patients presented low aVOR gains (<0.20) when the system was not activated, as expected.

### Conclusion

The results of the vHIT demonstrate that it is possible to restore the high-frequency aVOR with a chronically implanted, prototype vestibular implant. This result extends previous findings, confirming that our device successfully restores multimodal vestibular function, providing clear evidence that a vestibular implant might become an effective rehabilitation alternative for patients with a BVL in a near future.

## **Semicircular Canal Fibrosis as a Biomarker for Lateral Semicircular Canal Function Loss.**

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**Background and purpose.** Radiological abnormalities at the level of the semicircular canals are frequently observed without known correlation to a pathologic condition or function. They include narrowing or sclerosis on computed tomography (CT) and narrowing or signal loss on T2-weighted magnetic resonance imaging (MRI). Our hypothesis was that these radiological abnormalities at the level of the semicircular canals reflect an aspecific but advanced stage of vestibular decay.

**Materials and Methods.** Retrospective study in 35 consecutive patients with bilateral profound deafness eligible for cochlear implantation. Electronystagmography, CT, and MRI were performed as part of evaluation for cochlear implant candidacy.

**Results.** In our population, 31.4% had a bilateral lateral semicircular canal function loss, while 11.4% had a unilateral lateral semicircular canal function loss. CT-scan abnormalities did not correlate to lateral semicircular canal function loss at a statistically significant level. However, abnormalities observed on MRI correlated significantly with ipsilateral lateral semicircular canal function loss. This statistically significant difference was present not only if abnormalities were observed in at least one of the semicircular canals but also if we studied the posterior, superior, and lateral semicircular canals separately.

**Conclusion.** Semicircular canal abnormalities on T2-weighted MRI (including narrowing and/or signal loss in one or more semicircular canals) are correlated to lateral semicircular canal function loss.

## **Vibrotactile Biofeedback System and Bilateral Vestibular Loss: Pilot Study**

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**Purpose of the study:** Bilateral Vestibular Loss (BVL) main complaints are oscillopsia and imbalance. BVL has a strong negative impact on physical function and social interaction, decreasing quality of life. Vestibular Rehabilitation therapy is currently the mainstay in the treatment for these patients. However, rehabilitation therapy has shown to be less effective with patients with bilateral vestibular loss. There is no evidence of an effective treatment for patients with bilateral vestibulopathy. There is a clear need for a therapeutic solution. In this pilot study, the Vibrotactile Biofeedback System (VBS) were evaluated in subjects with severe bilateral vestibular deficit to investigate VBS efficiency for balance activities. **Materials and methods used:** The subject wearing the VBS system can set a reference vector at any desired moment, simply by pressing a button on the processor unit. Setting this reference vector is necessary for the VBS system to know its sensor orientation. Subsequently the processor calculates the vector difference. All patients were selected after ENT evaluation and recommendation. Subjects on wheelchair or with additional neurological deficits were excluded from the study. In addition, the Dizziness Handicap Inventory (DHI) was added to test protocol. In order to be included in this study, subjects should have DHI scores higher than 60. After the test with the VBS, subjects answered a simple questionnaire about different situations: sitting, standing and walking and the impact of VBS in general quality of life. **Results:** Statistical analysis presented a significant value difference between bilateral hypofunction and bilateral vestibular loss compared with other groups ( $p < 0.005$ ). **Conclusion:** This method could be crucial for some patients' quality of life. These preliminary results demonstrate the Vibrotactile Biofeedback System as an effective way to improve postural stability, especially in vestibular bilateral loss disorders. In our opinion, this device deserves more clinical evaluation and comparative studies.



## **Treatment of Benign Paroxysmal Positional Vertigo (BPPV) with the TRV Reposition Chair.**

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**Purpose of the study:** The primary objective of this study was to evaluate how successful BPPV reposition was with the TRV reposition chair. Despite the fact that the majority of BPPV patients obtain successful reposition by traditional repositioning maneuvers, still a great number of patients experience persistent BPPV with positional vertigo. These patients often present with either bilateral semicircular canal (SCC) affection or multi SCC affection. Subsequent referral includes thorough diagnosis and further treatment with this reposition chair. Rates of successful reposition among several subcategories of BPPV and a description of this atypical BPPV population will be included.

**Materials and methods used:** Prospective clinical trial. 83 patients, referred to our tertiary ENT dizziness clinic at Aalborg University Hospital, Denmark have been included. All patients underwent further diagnosis and treatment with the TRV reposition chair. Reassessment took place two to four weeks following previous treatment(s). Reassessment and subsequent treatments of patients continued until negative positional tests in the TRV reposition chair was obtained as well as a relief of subjective symptoms was noted by the patients. The obtained data was analyzed and compared by descriptive and inferential methods.

**Results:** Patients experienced vertigo for an average of 14 months at time of referral. Majority of patients had either multi SCC affection or bilateral SCC affection. Patients with multi SCC affection often had combination of posterior and lateral SCC involvement. Negative positional testing required an average of 1.6 treatments for posterior BPPV, 2.85 treatments for multi SCC affection, and 3.0 treatments for bilateral SCC affection. In order to categorize patients as cured, a relief of symptoms also had to be recognized by the patient. After initial treatment 55% of patients experienced a relief of symptoms and after three treatments 80% reported subjective improvement.

**Conclusion:** We conclude that the TRV-chair is an effective means of treating patients with resilient BPPV. Both patients with multi SCC affection and bilateral SCC BPPV seem to benefit from this treatment. At the IFOS Congress data for a total of 100 patients will be presented.

## **Effect of Auditory Distraction on Maintaining Balance in Patients with Vestibular Dysfunction and Seniors**

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### **1. Purpose of the study**

**To explore the effect of auditory distraction on maintaining balance in patients with vestibular dysfunction and seniors by measuring postural stability on Wii Balance Board.**

### **2. Materials and methods used**

**20 young healthy subjects (< 65 years old), 20 senior subjects (≥ 65 years old) and 40 patients with different vestibular pathologies, including patients suffering from unilateral Meniere's disease and treated by intratympanic gentamycin were recruited. Subjects were instructed to stand on a 6cm thick foam pad on a Wii balance board with eye open/eye closed, and to wear binaural headphones. During the test, subjects were continuously exposed to 1) two different pieces of news (in male/female voice) in the same language (i.e. French, English, Chinese, etc.) coming from left and right earphones, respectively; 2) one piece of news and one piece of strange noise (i.e. steps, alarm, fan, etc.) coming from left and right earphones, respectively. It is required for the subjects to maintain balance and pay attention to the speech at the same time. A customized APP (BalanceRite) will be used to analyze postural stability.**

### **3. Results**

**Young healthy subjects performed no difference when exposed to auditory distraction at both eye open and eye closed conditions. Senior subjects had higher chance to fall when exposed to certain types of auditory distraction. Patients with vestibular dysfunction and seniors were more easily to be distracted by auditory factors in eye closed condition than in eye open condition in the first three months after injection.**

### **4. Conclusion**

**Auditory distraction is an important factor in maintaining postural stability in seniors and patients with vestibular disorders. Further exploration will be needed to better predict the risk of falls in target population.**

**Abnormal vestibular function: The cause of motion sickness, Really ?**

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**Background & objective** The term ‘motion sickness’(MS) was a category for disorders elicited by exposure to unusual patterns of motion during passive transport. The mechanism of MS is now accepted based on sensory conflict or sensory mismatch theory. Many studies have been done to establish the cause of MS. MS is still poorly understood. The aim of this study was to examine the results of posturographic finding and caloric in MS susceptible and non-susceptible subjects.

**Materials & methods** Eight MS susceptible and six non-MS susceptible subjects were tested for vestibular function via computerized dynamic posturography and caloric test. Susceptibility to MS was determined by self-declaration and with MS susceptibility questionnaire validated into Thai version.

**Results** The equilibrium score and sensory analysis derived from posturographic findings and the slow phase velocity (SPV) eye response derived from caloric test show no statistical difference between two groups. However, mean subjective dizziness symptom score (VAS score) of cold water irrigation in MS susceptible subjects was more than non-MS susceptible subjects ( $p=0.005$ ).

**Conclusions** The results of this study suggested no vestibular deficits using posturography and caloric test in MS susceptibility subjects. However, this study suggested that MS susceptibility subjects report worse dizziness symptom (on VAS score) despite normal caloric SPV range.

## **POSTURAL CONTROL AND PSYCHOLOGICAL FACTORS: WHAT COULD BE DONE TO IMPROVE HEALTH CARE OF PATIENTS WITH VESTIBULAR SCHWANNOMA BEFORE SURGERY**

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### **PERFORMANCES POSTURALES ET FACTEURS PSYCHOLOGIQUES : CE QUI POURRAIT ETRE FAIT POUR AMÉLIORER LA PRISE EN CHARGE DES PATIENTS AYANT UN SCHWANNOME VESTIBULAIRE AVANT LA CHIRURGIE**

**OBJECTIFS :** identifier les relations entre les performances posturales, les représentations de la maladie et les stratégies de coping (adaptation et réponses du patient à la maladie) et les relations entre les performances posturales, les affects d'anxiété et de dépression et la qualité de vie (vécu du patient) des patients ayant un schwannome vestibulaire, trois jours avant la chirurgie.

**METHODE :** vingt-six patients ayant un schwannome vestibulaire, dont l'indication de chirurgie a été retenue, ont passé des tests de posturographie et ont rempli des questionnaires psychologiques, trois jours avant l'intervention.

Les évaluations ont été réalisées avec le Sensory Organization Test (SOT), le questionnaire révisé des représentations de la maladie (IPQ-R), le Brief-COPE, l'échelle d'anxiété et de dépression (HADS) et le World Health Organization Quality of Life (WHOQOL). Des corrélations entre les scores de posturographie et les scores des questionnaires psychologiques ont été calculées.

**RESULTATS:** Concernant l'adaptation et les réponses des patients à leur maladie, les troubles de l'équilibre étaient associés à davantage de conséquences quotidiennes et au déni comme stratégie de coping. Concernant le vécu des patients, les troubles de l'équilibre étaient associés à des affects d'anxiété et de dépression et ils avaient un impact négatif sur la qualité de vie physique et psychologique des patients.

**CONCLUSIONS:** une meilleure gestion des troubles posturaux pourrait permettre un moindre impact sur la vie quotidienne des patients, pourrait permettre de limiter le recours au déni comme stratégie de coping et pourrait également avoir un impact positif sur la qualité de vie des patients et sur les affects d'anxiété et de dépression.

Compte tenu des liens entre troubles de l'équilibre et facteurs psychologiques, les professionnels doivent être vigilants à la détérioration de l'un et l'autre et pourraient le cas échéant proposer un soutien psychologique, associé à une rééducation.

**TITLE: PERIPHERAL VESTIBULAR SYNDROME ASSOCIATED WITH SEVERAL METABOLIC PATHOLOGIES**

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**INTRODUCTION**

Balance is achieved by the correct relation and function between the vestibular, visual and proprioceptive systems, any type failure in one of them its capable of producing vertigo.

In international literature has been described associations between vertigo and different conditions or pathologies, especially with metabolic diseases, such as insulin resistance (IR), diabetes mellitus type 1 and 2 (DM), hypertension (HTA), dyslipidemia and overweight.

**OBJECTIVE**

Evaluate the association between peripheral vertigo and metabolic diseases.

**RESOURCE AND METHOD**

Observational and retrospective study of 82 patients diagnosed with Peripheral Vestibular Syndrome of unknown cause between the period of March 2015 to March 2016 in the Otorhinolaryngology Head and Neck Surgery Service of the Instituto de Prevision Social - Hospital Central- Asunción Paraguay.

It has been requested blood analysis such as glucose and lipid profile, as well as blood pressure measurement, cephalic impulse test to all patients who attended consultation during the period of study. Audiological tests such as tonal audiometry and impedanciometry were performed routinely

**RESULTS**

A total of 82 cases were studied, with an average of age of 55.6 years +/- 15.33 (15-90 years). 68% corresponds to female sex. 70% patients presented some metabolic pathology, 30% of prevalence corresponds to DM2, 55% corresponds to Hypertension.

In 40% of cases were observe bilateral auditory disorders corresponding to the sensorineural type, excluding its association with the Vertiginous Syndrome. The 37.5% presented vestibular disorder determined by the positive cephalic impulse test and its unilateral auditory affection.

**CONCLUSION**

The results support the hypothesis that metabolic diseases are more prevalent in patients with vertigo and that they play an important role in the appearance of this condition, especially in patients with non-specific causes.

Taking into account that the results agree with the world literature, we consider important the need for more diagnosis tests, such as caloric tests and videonystagmography, to achieve statistically significant results.

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## **EQ-IC-15**

### **Does providing early on-site vestibular rehabilitation within an emergency department setting benefit patients with Benign Paroxysmal Positional Vertigo (BPPV)?**

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#### **Purpose:**

This study aims to investigate the impact of providing early on-site vestibular rehabilitation therapy (VRT) for BPPV patients within an emergency department (ED) setting, in a major hospital in Singapore.

#### **Methods:**

Medical records of 71 patients with BPPV seen by VRT physiotherapists (PTs) based on-site in the ED of a major tertiary hospital over an 18 month period was retrospectively reviewed. Medical records from a second group of 40 patients with BPPV who presented to the same ED outside of the on-site VRT service hours and referred to outpatient VRT PT in the same period was also reviewed. Demographic data reviewed included age, gender and ethnicity of patients. Data relating to the clinical presentation including canal involvement (anterior, horizontal or posterior), type of BPPV (canalithiasis vs cupulolithiasis), and number of canals affected (single vs multiple) were also reviewed. Mann-Whitney U Test was used to calculate if there were differences in the demographics or clinical presentations between the two groups of patients, with a significance level set at  $p < 0.05$ .

Clinical outcomes reviewed included number of treatment maneuvers, number of treatment sessions, total treatment duration and percentage of patients who were successfully treated within one session. Mann-Whitney U Test was used to calculate if there was significant differences in the clinical outcomes of the two groups of patients, with a significance level set at  $p < 0.05$ .

#### **Results:**

No significant difference in demographics or clinical presentations were found between the two patient groups. The number of treatment sessions and treatment duration was significantly lower for patients who had early access to VRT on-site in the ED ( $p=0.015$  and  $p=0.037$  respectively). Number of treatment maneuvers required to resolve BPPV did not differ significantly between the two groups. 84.5% of patients who had early access to VRT on-site in the ED were successfully treated within one session, compared with 72.5% of patients who were treated in outpatient VRT clinics, although this difference was not statistically significant ( $p=0.129$ ). The average waiting time for patients to receive outpatient vestibular rehabilitation post-discharge from ED was 31.9 days.

#### **Conclusions and implications for practice:**

Providing access to VRT services on-site in an ED setting shows promising outcomes in reducing the number of treatment sessions and treatment duration required by patients with BPPV, potentially decreasing the cost of medical care for BPPV and reducing the time period in which these patients suffer unnecessarily from the debilitating effects of vertigo and dizziness.

## EQ-P-01

### A closer look at subjective caloric sensations: is there more to vertigo than spinning?

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**Background:** There is a prevailing opinion among physicians that a spinning sensation is the hallmark of peripheral vestibular pathology. Patients that report non-spinning type vertigo are often dismissed and inappropriately deemed to be non-vestibular in etiology.

**Objectives:** 1) To characterize the range of subjective sensations reported by patients during caloric vestibular stimulation. 2) To assess if the sensation can be correlated with the peak slow phase velocity (SPV).

**Methods:** Retrospective chart review of consecutive patients who underwent caloric testing between December 2014 and September 2015 at a tertiary care university hospital. The reported sensations experienced with each caloric irrigation were grouped into three broad categories (spinning/rotatory, other sensation, no sensation) and their prevalence assessed. The peak SPV associated with each irrigation was recorded. The mean SPV across sensation categories were compared using the Student t test.

**Results:** A total of 163 patients were included, 122 had normal calorics and 41 demonstrated unilateral weakness. Spinning/rotatory movements were the most commonly reported sensations (55-70%). No sensation was reported among 10-20% of patients. Non-rotatory sensations such as floating/falling, repetitive opposing movements, linear motions and vague spatial disorientation were grouped in the "Other" category and reported 20-25% of the time. Both lack of sensation and other sensations were more likely to be correlated with SPVs that were significantly lower than those associated with spinning/rotating sensations.

**Conclusions:** During caloric irrigation, subjective sensations other than spinning and rotating are reported 20-25% of the time and these tend to be associated with lower peak SPV. Non-spinning vertigo is not uncommon as a subjective description of vestibular sensation.



## ACUTE BILATERAL VESTIBULAR HYPOFUNCTION SECONDARY TO RELAPSING POLYCHONDritis.

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**Purpose of the study:** Bilateral vestibular hypofunction (BVH) is characterized by oscillopsia and unsteadiness, mostly during locomotion. It represents a heterogeneous disorder with different types of clinical features and different etiology. We report the case of an acute BVH secondary to relapsing polychondritis, its clinical presentation, diagnostic process and evolution. **Materials and methods:** A 63-year-old patient, previously healthy and autovalent, consulted in the emergency room for intense headache, left deafness and unsteadiness on gait, which started the same day upon waking up. In physical examination an increase in volume of both pinnae respecting the lobes was observed, in addition to bilateral superficial red eye that the patient recognized beginning at least three days earlier, compatible with perichondritis and bilateral conjunctivitis, respectively. The blood count revealed a leukocytosis, high c-reactive protein and a sedimentation rate. Computed tomography and magnetic resonance imaging of the brain showed no mass and no vascular or demyelinating lesions. The performed lumbar puncture was normal. Only at day ten evaluation by otorhinolaryngologist and rheumatologist was requested. The latter laboratory study was negative, except for C3 complement. Then, the otoneurological (OTN) physical examination revealed mainly retropulsion on the Romberg test, ataxic gait, pathological bilateral HIT and dynamic visual acuity, without any nystagmus on the video Frenzel study. In the OTN laboratory, the video HIT showed minimal gains in all semicircular canals, vestibular areflexia in the caloric test, and a profound sensorineural hearing loss in the left ear. With all these, the diagnosis of BVH and left ear deafness secondary to a relapsing polychondritis was made. Treatment with high doses of corticosteroids, metrotrexate and vestibular rehabilitation was started. **Results:** After twenty-one days the new OTN examination demonstrated a negative Romberg test (not falling) and a video HIT with partial recovery in all semicircular canals as well as a response (minimal) in the caloric test. The new audiometry showed a recovery of 30dB at low frequencies in the left ear. Given the auspicious results, treatment was continued and administration of intratympanic corticosteroids (ITC) in the right ear was added. At the time of writing this abstract the patient was in his second dose of ITC. **Conclusions:** The diagnosis of an acute BVH is a challenge for the clinician. The autoimmune etiology is a rare cause of this pathology and even more so is the relapsing polychondritis. Treatment based on corticosteroids and methotrexate in this case generated a good response.

## Application of oVEMP and cVEMP in Diagnosis of Ménière's Disease

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### Abstract

#### Background

The diagnosis of Ménière's disease, MD, still remains problematic. Between the attacks, MD is mostly asymptomatic. Conventional audio-vestibular testing usually fails to detect any abnormalities, except the later MD stages when the hearing and vestibular functions are dropped significantly.

Histopathologically, MD is proved to be an idiopathic endolymphatic hydrops. The excess endolymph production and/or impaired reabsorption processes initially is evident in the saccule and the cochlea. The utricle and semicircular canals are involved in pathological events later. These alterations are reflected in the proper audio-vestibular manifestations. The standard vestibular tests including caloric nystagmography can show variable responses in MD patients. In many cases the results are remain normal. Additional vestibular tests, e.g. ocular and cervical evoked myogenic potentials, oVEMPs and cVEMPs, respectively, are proved to be valuable tools for the proper estimation of the saccular and utricular functions.

#### Purpose

The aim of the present work was to estimate the oVEMP and cVEMP peculiarities in MD patients relative to the different stages of disease.

#### Materials and Methods

34 subjects with unilateral MD were included in the study group. Age- and gender-matched 30 persons with normal audio-vestibular function were checked in the control group. Along with the oVEMP and cVEMP recordings, all individuals underwent to pure tone audiometry, tympanometry, ENG, and magnetic resonance imaging. In both: test and control samples the oVEMP and cVEMP were registered to the air conducted sound stimuli.

#### Results

In the control group, the oVEMPs and cVEMPs appeared stable and reproducible. At the early MD stages cVEMPs were particularly disturbed while at the advancing stages both cVEMPs and oVEMPs were altered pathologically. In the study group, the N1-P1 amplitude of cVEMPs and oVEMPs as well as interaural amplitude difference, IAD, statistically differed from those in the control sample. In 33% of patients of III-IV MD stage, oVEMP and cVEMP were absent, while in reminder 67% the amplitudes of both potentials were significantly reduced on the pathological side that resulting in the respective IAD expansions. In all patients of IV stage, caloric nystagmography results were reduced on the pathological side as well.

#### Conclusion

It was reached that oVEMP and cVEMP approaches along with the standard vestibular tests could be apply as an additional tests for the MD diagnosis relative to the different stages of disease. The oVEMP and cVEMP recordings could be applied as well for the estimation and monitoring of the treatment procedures.

## **Are covert saccades functionally relevant in bilateral vestibular areflexia?**

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**Introduction:** The vestibulo-ocular reflex (VOR) plays a key role in gaze stabilization during high velocity head accelerations. Impairment of the vestibular system thus decreases dynamic visual acuity which negatively impacts the quality of life of patients with bilateral vestibular hypofunction (BVH). In order to compensate for their lack of VOR, patients with BVH use saccades to redirect their fovea toward the object of interest during high velocity head rotations. These saccades can be Overt, occurring after, or Covert, occurring during the head movement. The aim of our study was to test the hypothesis that presence of covert saccades (CS) leads to better functional visual outcome, tested on dynamic visual acuity (DVA). This study further questioned which characteristic of these saccades are the most relevant to improve visual outcome amongst mainly latency, organization and gain.

**Methods:** We included prospectively 18 patients with chronic BVH (> 6 months). Subjects underwent evaluation of their dynamic visual acuity (DVA) in the horizontal plane using a marketed device that tracks head velocity and presents visual optotypes at precise head velocity threshold. We also recorded head and eye position during horizontal head impulse test using a lightweight portable vHIT device with a sampling rate of 250Hz for both head and eye movements. Head and eye position and velocity data were then manually analyzed using a custom MATLAB interface. Statistical analysis was done using Person's product-moment correlation.

**Results:** 36 ears/sides were tested. The median age of our patient group was 64 years. The mean residual VOR gain was 0,25 and the mean dynamic visual acuity was 0,47 LogMAR. We found no correlation between residual VOR gain and DVA ( $r=-0,15$ ;  $p=0,40$ ). DVA was statistically increased with increased CS frequency ( $r= -0,56$  ;  $p<0,01$ ), decreased CS latency ( $r=0,53$  ;  $p=<0,01$ ) and increased CS gain ( $r= -0,52$  ;  $p<0,01$ ). Organization of CS did not modify DVA.

**Conclusion:** CS seems to play a major functional role in patients with BVH by ensuring better DVA. Conversely residual VOR does not seem to affect DVA. These findings emphasize the need for specific rehabilitation technics that focus on triggering covert saccades. The physiological origin of covert saccades still needs to be understood.

## Association between the caloric test and vHIT in acoustic neuroma

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### Introduction

The video head impulse test (vHIT) has recently been focused on the easy test for a semicircular canal function. The examination is evaluated by the ocular movement during passive quickly head movement to a lateral side. The results coincide with those of caloric test in the cases with vestibular neuritis but differ from in some cases with Meniere's disease. The aim of this study was to examine an association between the results of the caloric testing and vHIT in the cases with acoustic neuroma.

### Materials and methods

The subjects consisted of 20 cases with acoustic neuroma confirmed in MRI who underwent both the caloric testing and vHIT. The vHIT were examined using ICS Impulse. When VOR gain of vHIT was lower than 0.88 or and catch-up saccade was detected, we defined the result as abnormal. When CP% calculated from monothermal caloric exceeded 25%, we defined a result to be abnormal. In addition, the results on cervical and ocular vestibular evoked myogenic potential (cVEMP and oVEMP) were also evaluated.

### Results

Abnormal results were shown in 85% on cVEMP which attribute from the function of the nerve. The abnormal ratio were 65%, 60% and 60% on caloric testing, oVEMP and vHIT respectively which attribute from the function of superior vestibular nerve. While 6 of 7 cases with normal results on caloric testing showed normal results on vHIT, 11 of 13 cases with abnormal results on caloric testing showed abnormal results on vHIT ( $p=0.004$ ).

### Discussion

The abnormal ratio on the vHIT was lower than those on cVEMP but was almost same as those on caloric testing and oVEMP. The result depends on the fact that most of acoustic neuroma originate from the inferior vestibular nerve. If the results of the caloric testing was considered gold standard of the function of superior vestibular nerve, it was suggested that the results of vHIT could evaluate the nerve in the cases with acoustic neuroma.

**EQ-P-06**

## **Bilateral vestibular hypofunction in the time of video head-impulse test**

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**Purpose of the study:** Bilateral vestibulopathy is a clinical syndrome in which laboratory testing plays a crucial role for its diagnosis. Due to the existence of new modalities of vestibular examination we were interested in knowing whether or not they have provided an increase in the frequency of the finding, a change in the different clinical categories diagnosed and if new patterns of bilateral hypofunction could be defined.

**Materials and methods used:** Two periods of similar time (5 years) were retrospectively evaluated in our laboratory and the demographic and clinical data and, tests results from 4576 patients were reviewed. In the first period, diagnosis was based on caloric and rotatory chair tests and in the second, on the video head-impulse test (vHIT).

**Results:** Of the patients included, 3.77% in the first period and 4.58% patients, in the second, met the criteria for bilateral vestibular hypofunction. Clinical categories were slightly different as the number of patients changed between then and new were included. In addition to a vestibular deficit in all 6 semicircular canals' receptors a pattern of only 5 canals deficiency was found probably related to a sequential or asymmetric presentation.

**Conclusions:** The evaluation of vestibular function with the vHIT allows to increase the number of patients diagnosed of a bilateral vestibular hypofunction. New categories depend probably not only on the availability and accessibility for a complete vestibular and visual-vestibular evaluation but also on recent advances in defining vestibular disorders. Bilateral vestibular hypofunction manifests with very different patterns and a definition (clinical and at laboratory) is needed, in particular when all 6 semicircular canals and both maculae are available for testing.

**EQ-P-07**

## **Canal paresis and associated disorders in posterior canal Benign Paroxysmal Positional Vertigo**

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**Purpose of the study:** The objective of this study was to investigate canal paresis and associated disorders with posterior canal benign paroxysmal positional vertigo. **Materials and Methods:** Retrospective study in patient with BPPV attending the outpatient ENT and Hearing and balance Clinics. The study group consisted of a total of (108) patient, 63 females and 45 males of unilateral benign paroxysmal positional vertigo. Their age ranged from 27 years to 79 years of idiopathic and associated disorders with BPPV. **Results:** In this study the ratio of males to females was 1:1.4. The patients have a mean age of  $48.6 \pm 12.4$  years. Sixty nine patient were idiopathic BPPV with a percentage of 63.8 % and (39) patient has comorbid condition with the BPPV with a percentage of 36.2 %. On caloric test results for benign paroxysmal positional vertigo 36 patients have caloric abnormalities (33.3 %), 21 patients have canal paresis (19.4 %), and 15 patients have direction preponderance (13.8%). **Conclusion:** BPPV can be idiopathic or associated with other diseases. It is more common in females than males. Canal paresis is commonly found in cases of BPPV either in the same side or the other non affected side. It is recommended to include VNG test battery as a routine test for evaluation of BPPV as canal paresis is a commonly associated with this disease.

## Canal paresis in the caloric test is related with the severity of hydrops rather than vestibular dysfunction in Ménière's disease

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**Objectives:** The explanation for the mechanism of canal paresis (CP) in the patients with Ménière's Disease (MD) is controversial. The aim of this study was to prove morphologic correlation of canal paresis in MD patients with normal vHIT with vestibular hydrops level by inner ear MR imaging.

**Materials & Methods:** In study I, 46 patients with definite unilateral MD (n=24) and vestibular neuritis (n=22) were retrospectively enrolled. Every patient had abnormal canal paresis in bithermal caloric tests. Prevalence of positive vHIT were compared between two diseases. In study II, total 18 MD patients who had vertigo attacks within last 3 months were prospectively recruited for inner ear MR scanning, vHIT test and caloric test. MR imaging was performed at 4 hours after intravenous administration of single dose of Gadolinium (Gd). Using previously reported HYDROPS2-Mi2 MR imaging, vestibular hydrops ratio (endolymph volume/total lymph volume = %VH) was measured separately by two observers. For 16 patients with normal vHIT, the correlation between the responses by caloric tests and the severity of vestibular hydrops was investigated. The correlation between vestibular hydrops ratio(%VH) and average of peak slow phase velocity (PSPV) and between canal paresis (CP) and relative vestibular hydrops ratio (%RVH) was evaluated ( $[\%VH_{affected} - \%VH_{unaffected}] / [\%VH_{affected} + \%VH_{unaffected}]$ ).

**Results** In study I, prevalence of abnormal vHIT was significantly lower in the patients with MD (12.5%) compared to the patients with VN (81.8%)( $p < 0.001$ ). In study II, the morphologic correlation between caloric result and vestibular hydrops was evaluated (n=16). The vestibular hydrops ratio of the affected ear was significantly correlated with caloric responses ( $r_s = -0.569$ ,  $p$ -value = 0.024). In addition, the value of CP was significantly correlated with %RVH ( $r_s = 0.602$ ,  $p$ -value = 0.014).

**Conclusions:** Most patients with unilateral MD showed normal VOR response in vHIT even though they had canal paresis in caloric tests. The severity of vestibular hydrops in MR imaging was correlated with canal paresis in the MD patients with normal vHIT. Therefore, we concluded that canal paresis of caloric tests in MD patients may represent the severity of hydrops in the inner ear rather than vestibular dysfunction.

**EQ-P-09**

## **Cervical Vestibular Myogenic Potentials (C-VEMP) in Healthy Individuals: Comparison between Tone-Burst and Click**

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**Introduction:** Cervical Vestibular Evoked Myogenic Potential (c-VEMP) is one of the clinical tools to evaluate vestibular function. The c-VEMP can be recorded from sternocleido mastoid muscle by auditory stimulation with various sound stimuli. The aim of this study was to compare the VEMP responses evoked by tone-burst with those evoked by click stimuli in healthy young individuals.

**Methods:** Thirty healthy volunteers (15 males, 15 females; 60 ears). To perform the test, it was used an evoked potential equipment (Eclipse Platform, EP25, Interacoustic, Denmark) with a module for c-VEMP. To obtain the c-VEMP response, it was presented 200 monaural stimulation with tone burst and click, in a randomized way for each subject, with intensity 100dB HL at a frequency of 500 Hz.

**Results:** The sample consisted of 30 subjects, 15 women (50%) and 15 men (50%), aged 18-36 years. The mean age was 27.2 ( $\pm 5.4$ ). All subjects had c-VEMP responses in both tests, with both stimuli. The latencies p1 and n1 of tone-burst c-VEMP were significantly longer and the p1-n1 amplitudes were significantly greater as well.

**Conclusion:** A different database should be established before clinical application of c-VEMP for different stimuli. We recommend it because comparing tone-bur stand click, the latencies and amplitudes were significantly different, as observed among several labs.



## **Chulalongkorn Vestibular Balance Exercise for Rehabilitation in Persons with Various Types of Vestibular Disorders**

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### **Chulalongkorn Vestibular Balance Exercise for Rehabilitation in Persons with Various Types of Vestibular Disorders**

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**Objective :** To study the efficiency of Chulalongkorn vestibular balance exercise for rehabilitation in persons with various types of vestibular disorders.

**Material and Method:** Fifty-eight patients with various types of vestibular disorder were identified by a retrospective chart review. Thirty of the 58 patients met the inclusion criteria of having dizziness and unsteadiness post vestibular diseases with complete record of neuro-otologic examination, vestibular tests and had been followed up for at least 3 months. These patients were treated with Chulalongkorn vestibular balance exercise and were evaluated for dizziness symptoms and balance bedside test at the beginning of treatment, one month and three months after the exercise.

**Results:** The average age of the patients was  $50.34 \pm 14.04$  years. The average of duration of exercise program was 5.6 months. There were 6 cases of vestibular neuronitis; 5 cases of post acoustic neuroma removal; 4 cases of acute cochleovestibular loss; 3 cases of motion sickness; 2 cases of cerebellar atrophy; 3 cases of multisensory dizziness; 4 cases of post meningitis with deafness; and 3 cases of ototoxicity. After the exercise, improvement of dizziness symptoms could be found in all groups of the diseases at one month and three months. The objective of balance bedside test was improved in most cases except motion sickness, multisensory dizziness and cerebellar atrophy. The overall percentage of improvement of dizziness was statistically significant at one month and three months ( $p=0.0373$  and  $p<0.001$ ). However, the overall balance bedside test was statistically improved at three months after the exercise ( $p=0.034$ ).

**Conclusion:** Chulalongkorn vestibular balance exercise gave significantly effective results in the treatment of dizziness and unsteadiness from various types of vestibular disorder. This study demonstrated improvement of dizziness symptom post-exercise at one month and three months with statistical significance. The balance bedside test was also statistically significant improved at three months post-exercise.

**Key words:** Vestibular balance exercise, vestibular rehabilitation, physical therapy.

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**Clinical implication of cervical vestibular evoked myogenic potentials in benign paroxysmal positional vertigo**

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**Purpose of the study:** To evaluate the value of cervical vestibular evoked myogenic potential (cVEMP) as a prognostic factor for benign paroxysmal positional vertigo (BPPV).

**Materials and Methods:** We reviewed 65 patients with BPPV who underwent cVEMP. Patients were divided into two groups according to resistance to repositioning maneuver, whether BPPV was resolved after a single repositioning maneuver. Univariable and multivariable analysis were performed with age, gender, affected semicircular canal, affected side and VEMP parameters to find out the associated factors with resistance to repositioning maneuver.

**Results:** In the univariable analysis, cVEMP interaural amplitude difference (IAD) ratio, affected semicircular canal and affected side showed a better association ( $p < 0.10$ ) with the resistance to repositioning maneuver. In the multivariable analysis, decreased cVEMP IAD ratio at affected side ( $\leq -25\%$ ) ( $p = 0.043$ , OR 4.934; 95% CI 1.049 to 23.212) and affected semicircular canal ( $p = 0.049$ , OR 3.780; 95% CI 1.005 to 14.216) remained as associated factors.

**Conclusion:** Decreased cVEMP IAD ratio at affected side is associated with the resistance to repositioning maneuver. BPPV patients with decreased cVEMP IAD ratio at affected side have more likelihood that BPPV persists after a single repositioning maneuver. So, cVEMP may be a test predicting the prognosis of BPPV. Decreased cVEMP IAD ratio at affected side suggests high likelihood that BPPV persists after a single repositioning maneuver.

## **Clinical relevance of head shake static posturography**

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### **Objectives**

Recent research has demonstrated an increase in sensitivity to identifying peripheral vestibular system asymmetry when horizontal head movements were added to the dynamic posturography Sensory Organization Test (SOT) performed with eyes closed only. No data on MCTSiB protocol were found.

In this study we have tested hypothesis that head movements added to standard static posturography test (HSposturography) would improve identification of vestibular disorders.

### **Study group and methods**

The study comprised 231 patients ( $57 \pm 13$  years old) referred to Audiology clinic due to balance and hearing problems. The clinical examination and videonystagmography tests were performed to diagnose patients and to divide them into 7 clinical groups: 1. Healthy – 36 subjects with no balance problems; 2. BPPV (37 subjects); 3. Uncompensated unilateral weakness (UV, 31 patients); 4. Compensated unilateral weakness (cUV, 14 patients); 5. Phobic vertigo (PV, 57 patients); 6. Migraine and central vertigo/dizziness (C, 46 subjects); 7. Bilateral vestibular impairment (BVL, 10 subjects). There was no differences in age between groups.

Static posturography tests were performed twice, first with standard MCTSiB procedure (1. eyes open, firm; 2 eyes closed, firm; 3 eyes open, foam; 4 eyes closed, foam) and then repeated with head movements controlled by metronome set at 1 Hz with head movement range of 30° peak-to-peak.

### **Results.**

The Wilcoxon signed-rank test results revealed statistically significant increase of body sway velocities measured during the HS posturography tests when compared to standard tests. ANCOVA analyses revealed no differences among clinical groups for body sway in standard posturography besides the condition with eyes closed, on foam, which was worse in BVL group only. Statistically significant differences between clinical groups were observed in HSposturography for all four conditions. A one sample t-test indicates that UV group was the only one to be worse in all conditions as compared to healthy subjects.

### **Conclusion.**

HSposturography is the useful tool to demonstrate that the balance performance depend on clinical status of the patient. Uncompensated unilateral weakness is the most identifiable when using HSposturography in contrary to standard posturography.

**Aknowledgment.** The study was supported by the funds of the Polish National Center for Research and Development; project No STRATEGMED/INNOREH/266299/2016.

**EQ-P-13**

## **Comparison of cVEMP by air- conducted sound and bone-conducted vibration in vestibular schwannoma patients**

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**Purpose:** It is known that cervical vestibular evoked myogenic potential (cVEMP) can be recorded on the contracted neck muscles with air- conducted sound stimulation and the response is originated from sacculus. Similar responses were also recorded by fore head bone-conducted vibration, but the origin of the response is still not clear. In this study, we recorded cVEMP by stimulating with air- conducted sound and bone-conducted vibration to the forehead. We compared the responses to investigate the origin of cVEMP with bone-conducted vibration to the forehead.

**Methods:** Data were obtained in 33 patients with vestibular schwannoma. The vestibular examinations were performed preoperatively. We determined cVEMP obtained with air-conducted sound as acVEMP and obtained responses with bone vibration to the forehead by using Minishaker as bcVEMP. We also tested vestibular function by caloric and ocular VEMP testing. oVEMP was measured by using bone-conductive vibration to the fore head. We compared the results of bcVEMP, with acVEMP, oVEMP and the caloric test.

**Results:** In bcVEMP, normal in 6, decreased response in 7, no response in 20.

Statistical analysis was performed with Kappa Coefficient. The bcVEMP did not correlate with acVEMP, and confirmed correlation with oVEMP and caloric test.

**Conclusion:**

We speculated that bcVEMP reflects mainly superior vestibular nerve function, in particular reflects utricular function.

## **CONFLICTING RESULTS BETWEEN V-HIT AND CALORIC TEST IN MENIERE DISEASE**

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### **INTRODUCTION:**

Vestibular hypofunction in Ménière's disease (MD) is usually shown by caloric test as it studies horizontal semicircular canal function. Horizontal V-HIT (hVHIT) evaluates the same canal but in a higher frequency. The aim of this study was to compare caloric test results with horizontal V-HIT findings in defined MD.

### **MATERIAL AND METHODS:**

We report 71 patients (42 females, 29 males, mean age 61.25 years) with defined MD (by the Bárány Society criteria) studied from March 2014 to July 2015. All of our cases had sensorineural hearing loss with a mean PTA threshold of 51.78 dB. A caloric test (with air stimulation at 50°C and 28°C) and hVHIT were realized the same day in every patient by high-qualified staff. A caloric response asymmetry of 22% was considered as unilateral weakness (UW) and gain 0.05). Pearson correlation coefficient did not find a linear relation between both variables.

### **CONCLUSION:**

In defined MD, a UW finding in the caloric test is much more common than a pathologic gain in hVHIT. Traditional caloric test is more sensitive to canal dysfunction in this disease than hVHIT. However in our study we do not find statistically significant results. More studies with a greater sample and a longer follow-up time are needed in order to define the usefulness of hVHIT as a tool to evaluate semicircular canal dysfunction in MD.

## **Effect of Goggle Slippage on the Video Head Impulse Test Outcome and Its Mechanisms**

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### **OBJECTIVES:**

The aim of this study was to quantitatively measure the tightness of the goggle strap during the video head impulse test (vHIT) and to identify slippage-induced artifacts according to tightness. We aimed to elucidate the mechanism of faulty gain caused by goggle slippage and explain the typical artifacts associated with it.

### **SUBJECTS AND METHODS:**

An endotracheal tube cuff manometer was coupled to the EyeSeeCam vHIT system (Interacoustics, Assens, Denmark) to monitor strap tightness. The instantaneous gain (40, 60, and 80ms) and regression gain were compared in eight healthy subjects under the following strap tightness conditions: loose (25cm H<sub>2</sub>O), tight (35cm H<sub>2</sub>O), and very tight (45cm H<sub>2</sub>O). To elucidate the mechanism of faulty gain caused by goggle slippage, a fake fixed pupil with a vestibule ocular reflex (VOR) gain of 0 was attached to the subject's eyelid. The faulty gain recording pattern was analyzed as the tightness of the strap was decreased.

### **RESULTS:**

The most common slippage-induced artifacts were: 1) initial backward eye movement toward the head movement, 2) acceleration bumps, 3) high gain, and 4) deceleration bumps. At 40ms, the gain was significantly lower in the 25cm H<sub>2</sub>O condition ( $0.68 \pm 0.32$ cm H<sub>2</sub>O) compared with the 45cm H<sub>2</sub>O condition ( $0.90 \pm 0.26$ cm H<sub>2</sub>O). At 80ms, the gain was higher for the 25cm H<sub>2</sub>O condition ( $1.24 \pm 0.27$ cm H<sub>2</sub>O) compared with the 45cm H<sub>2</sub>O condition ( $1.16 \pm 0.30$ cm H<sub>2</sub>O). These findings were progressively more obvious as the tightness of the strap decreased in a dose-dependent manner. When the fake pupil was recorded, initial backward eye movement toward the head movement (negative VOR gain) and eye tracing mimicking a small VOR (positive VOR gain) were recorded, despite the fake pupil having absolutely no movement. These artifact recordings are presumed to be related to the faulty low (40ms) and high (80ms) gain calculation.

### **CONCLUSIONS:**

Slippage-induced artifacts are presumed to be because of the slingshot-like movement of the goggles during head movement in three different phases (lagging, overshooting, and bouncing of the goggles). Monitoring the pressure of the strap tightness may be a solution for minimizing this slippage. A strap tightness of at least 45cm H<sub>2</sub>O is required for reliable vHIT recording and gain calculations.

## Head Impulse Tests in Cerebellopontine Angle Tumor

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**Background and Purpose:** Tumors involving the cerebellopontine angle (CPA) pose a diagnostic challenge due to its variable manifestations. Head impulse tests (HITs) have been used to evaluate vestibular function, only a few studies have explored head impulse gain of the vestibulo-ocular reflex (VOR) in patients with vestibular schwannoma. To prove that the head impulse gain of the VOR is an indicator of tumor size in unilateral CPA tumors.

**Methods:** Twenty eight patients (21 women, mean age=64±12) with a unilateral CPA tumor underwent a recording of the HITs using a magnetic search coil technique. Patients were classified into the non-compressing (T1~T3) and compressing (T4) groups according to the Hanover classification.

**Results:** Most (23/28, 82%) patients showed abnormal HITs for the semicircular canals (SCCs) on the lesion side. The bilateral abnormality of HITs was more common in the compressing than in the non-compressing group (80% vs. 8%, chi-square test,  $p<0.001$ ). The tumor size was inversely correlated with the head impulse gains of the VOR in either direction.

**Conclusion:** Bilaterally abnormal HITs indicate a larger tumor in patients with a unilateral CPA tumor. The abnormal HITs in the contralesional direction may be explained by adaptation, or compression and resultant dysfunction of the cerebellar and brainstem structures. Serial evaluation of the HITs may provide information on tumor growth, and thus reduce the number of costly brain scans during the follow-up of patients with CPA tumors.

## **Influence of post rotatory transient vestibular tone imbalance on muscular synergies during walking and running.**

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**Introduction:** The vestibulospinal pathway is an effector control of the vestibular nucleus, whose stimulation generates an increase in the muscular activation during the stance phase of walking without affecting the muscular coordination (Orlovsky, 1972). Increasing movement speed (i.e. walk to run transition) inhibits peripheral vestibular afferents in favour of central automatic motor programs (Brandt et al., 1999 ; Dakin et al., 2013). The aim of this study was to quantify the impact of a transient vestibular tone imbalance (TVTI) on the level of muscular activity and muscular synergies during walking and running.

**Methods:** 11 healthy participants aged between 20 and 28 years took part in the study. Participants were instructed to walk or run for a distance of 10 m with closed eyes (control conditions). Also, participants performed the same tasks after 10 rotations on an armchair (Framiral®, Grasse, France) at an angular speed of one revolution per second, before being abruptly stopped (experimental conditions). For each condition, muscular synergies were extracted via non-negative matrix factorization (Lee & Seung, 2001) from the electromyographic (EMG) recordings of 8 lower-limb muscles (Myon 320, AG, Zurich, Switzerland) which were beforehand low-pass filtered using a cut-off frequency of 8 Hz. The muscle activity was normalized ( $\Delta$ EMG, %) by dividing the mean muscle activity during the stance of the experimental condition with the one of the control condition. The lateral deviation (in °) was collected by a Vicon 3D analysis system. Muscle synergy similarity between experimental and control conditions was computed with correlation coefficients (r).

**Results:** The EMG results showed that muscular synergies were similar across conditions (i.e. 4 synergies with or without stimulation). No significant difference of r-values ( $p > 0.64$ ) was found between walking and running (mean r : 0.79-0.96). There was a higher lateral deviation ( $p < 0.001$ ) during walking ( $22.8 \pm 8.4^\circ$ ) than running ( $8.5 \pm 3.6^\circ$ ) with TVTI.  $\Delta$ EMG increased significantly ( $p < 0.01$ ) in the stance phase of walking compared to running for the first two muscle synergies.

**Conclusion:** As previously found, the vestibular cues are inhibited with the increase of locomotion speed (Brandt et al., 1999; Dakin et al., 2013). But, for the first time in humans, we determine that the spinal networks for automatic locomotion were not affected by vestibular afferences, in agreement with previous findings on animals (Orlovsky, 1972).



## **Megadolicho basilar artery as a cause of asymmetrical sensorineural hearing loss**

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**Introduction.** Retrocochlear pathology is an important part of the differential diagnosis of sensorineural hearing loss. Arteriovenous malformations, aneurysms and hemangiomas are described within vascular causes. The megadolicho of the basilar artery is an abnormal dilatation and extension of the trunk of the basilar artery. It is usually asymptomatic, but can manifest clinically by compression of cranial nerves, ischemic symptoms or intracranial hemorrhage.

**Aims.** To characterize an uncommon vascular cause of unilateral cochleovestibular compromise

**Material and method.** We present the case of a female patient of 54 years, with a history of 2 years of progression of progressive hearing loss of the right ear associated with objective vertigo and ipsilateral tinnitus. It also presents right hemicranial head irradiation to the mandibular zone. The patient is studied with audiometry, which reveals anacusis of the right ear. Caloric test shows areflexia of the right vestibular nerve. The computed tomography of the ears demonstrates megadolicho of the basilar trunk with a curve to the right, occupying the right pontocerebellar angle interfering with the cisternal path of the right facial acoustic complex and displacing the trunk. The nuclear magnetic resonance of the brain confirms the diagnosis of dolicoectasis of vertebrobasilar vessels with partial occupation of the right cerebellar angle with mass effect on the brainstem.

**Results, discussion and conclusions.** The treatment of this disease is generally conservative, through observation and use of antiplatelet agents according to embolic risk. This pathology poses a high risk of neurological deterioration at 5 years, mainly secondary to ischemic events and compression at the trunk level, which is why close monitoring and control of our patient is essential.

## **Peak saccade velocity as an indicator of horizontal vestibular canal paresis in the suppression head impulse paradigm (SHIMPs)**

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### **1. Purpose of the study**

To explore whether peak saccade velocity in the suppression head impulse paradigm (SHIMPs) successfully indicate the acute and chronic stage of vestibular loss in patients suffering from different vestibular pathologies.

### **2. Materials and methods used**

35 normal subjects and 57 patients with different vestibular pathologies, including unilateral vestibular loss (UVL) and bilateral vestibular loss (BVL) were tested in SHIMPs. In SHIMPs, 10 times head impulses were delivered by the clinician at high velocities to the left or right side, respectively. The Patients were instructed to fixate on a red spot generated by a head-fixed laser projected on the wall. Healthy subjects made a large anti-compensatory saccades at the end of each hear turn (a SHIMP saccade). The peak saccade velocity of SHIMP saccades was analyzed in each group. A traditional video-head impulse test (HIMPs) was systematically performed in all subjects.

### **3. Results**

At the acute stage after a complete UVL, patients had zero or a few anti-compensatory saccades when head turns toward the lesioned side. In contrast, the anti-compensatory saccades were much higher during head rotation toward the intact side and/or compared with the saccades measured in control subjects. At the chronic stage, some of the patients recovered the ability to perform SHIMP saccades at each head turn toward the lesioned side, but very often these saccades were of significantly lower velocity. In BVL patients, no anti-compensatory saccades, or only significantly smaller ones, could be detected for head turns to both sides.

### **4. Conclusion**

SHIMP is a sensitive and specific test to detect a complete horizontal canal loss at the acute stage by analyzing the peak saccade velocity of SHIMP saccades. It also reflects the moderate decrease of horizontal vestibulo-ocular reflex gain in patients at chronic stage.

## **Reliability of Head Impulse Test and Unterberger Test in chronic vertigo patients study**

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**Purpose of the study:** The main goals of vestibular examination are to identify any degree of vestibular impairment and to localize the affected site of lesion. To perform that, among others, we currently use the Unterberger Test (UT), the Head Impulse Test (HIT) and the Caloric Test (CT), being the latter our gold-standard. With this study, we aimed to evaluate the degree of agreement between these tests and their accuracy to detect peripheral vestibulopathy.

**Materials and methods used:** Retrospective analysis of 56 patients with vertigo for more than 8 weeks, simultaneously submitted to UT, HIT and CT, followed by the analysis of the agreement between the performed tests and our gold-standard (HIT/CT and UT/CT) and, finally, the 3 tests (UT/HIT/CL) with SPSS® v.22. The exclusion criteria were age under 18, the presence of central nervous pathology, chronic otitis media and temporal bone fracture, and CT with errors or artifacts.

**Results:** Our final sample (n=50) was distributed in 5 groups: 1- Ménière (M) - n=12; 2- BPPV - n=12; 3- Unsteadiness (U) - n=10; 4- (PVN) Post-acute vestibular neuritis - n=6; 5- Multiple vertigo episodes (minutes to hours) without a definitive diagnosis - n=10. Overall, the HIT/CT had 60% of accuracy, and the UT/CT 54%, with statistically significance ( $\chi^2 - p=0,001$ ). We did not see a higher correct association of UT/CL, HIT/CL and UT/HIT/CL with the increasing of canal unilateral weakness ( $\chi^2 - p=0,46; 0,60; 0,19$  respectively). The 3 tests had concordant results in 46% of patients. The best UT/CT association obtained was in PVN and BPPV groups (83,3% and 66,7%). The best HIT/CT association obtained were in 90% of U patients followed by 66,7% of patients in PVN group. The group with the best 3-tests accuracy was the PVN (66,7%). Finally, in this study there was no influences of Diabetes Mellitus and osteoarticular pathology in UT/CL ( $\chi^2 - p=0,32$ ), as well as there was no influence of visual deficits, explicit in clinical record, in HIT/CL ( $\chi^2 - p=0,90$ ).

**Conclusion:** In our series HIT/CT had higher correlation and higher accuracy than UT/CT to detect the affected side, no matter the unilateral weakness value. Nevertheless, no bedside test replaces CT, which allows us to say that none should be dispensed, but all must be integrated and analysed case by case.

**EQ-P-21**

**Sensitivity and Specificity of the Head Impulse Test in patients ENT Dpt. of Hospital de Clínicas.**

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**Sensitivity and Specificity of the Head Impulse Test in patients ENT Dpt. of Hospital de Clínicas.**

**Ortiz JL; Báez M; Liu T; Heinichen J**

**Purpose of study:** In the study of a vertiginous syndrome, anamnesis and physical examination are important. The head impulse test represents a semiological alternative for the assessment of vestibular function. It consists of a simple and fast test for the basic otoneurological physical examination. This test is based on the evaluation of the vestibular-ocular reflex indemnity. There is a need to evaluate patient with physiological procedure to determinate a correct diagnostic.

**Materials and methods:** We performed a prospective, descriptive, cross-sectional study. Patients with suspected paresis or acute or chronic vestibular paralysis who were consulted at the Otoneurology Department of the Otorhinolaryngology Service of the Hospital de Clínicas National University of Asuncion during the period November-December 2014 were evaluated. The sensitivity and specificity of the Head impulse test Using the caloric test as gold standard.

**Results:** A sensitivity of 85.7% and a specificity of 25% were obtained. The positive predictive value obtained was 66.7% and the negative predictive value was 50%.

**Conclusion:** Head impulse test is a high sensitivity procedure with a valuable positive predictive value for vestibular paralysis.

## Stabilogram of patients with otolithic vertigo

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### 1. Purpose of the study

Due to the development of VEMP test, clinical concept of the otolithic vertigo (OV) has been established. The rectilinear moving sensation with up-to-down direction, anteroposterior direction, and right-and-left direction relate to the otolith disorders. However, it has not yet been sufficiently reported whether posture control is accompanied in patients with OV. In order to clarify the question, we investigated the result of their stabilogram.

### 2. Materials and methods used

Thirty patients with OV were enrolled in this study. The tentative diagnostic criteria of OV was following as; 1) the complaint was of non-rotatory disequilibrium, 2) abnormal results were shown on cVEMP and/or oVEMP, 3) there were no abnormal results from routine examinations, 4) there were no cerebellar signs or intracranial lesions detected by brain MRI. The results of stabilography such as outer circumference area and the unit time trajectory length were evaluated using deviation values in order to avoid influences of age and gender. The function of saccule and utricle were evaluated by cVEMP and oVEMP respectively.

### 3. Result

The outer circumference area in OV was larger than those in the control group. The outer circumference area and the unit time trajectory length in the utricular dysfunction group were larger than those in the saccular dysfunction group,

### 4. Conclusion

Abnormal postural control is associated with OV patients, and in particular the utricular organs had more influence on the postural control than saccular organs.

**EQ-P-23**

## **Study on 166 Acoustic Neuroma patients with Electro-nystagmography**

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### **Purpose of the study**

**Eye Tracking Test (ETT) and Optokinetic Pattern (OKP) of acoustic neuroma patients are analyzed before and after operation.**

### **Materials and methods**

**We analyzed 166 patients who underwent Electro-nystagmography between 2013 and 2016. The number of male patients totaled 64 and females totaled 102. The patients' age ranged from 11 to 79 years, and the average was 41.1 years. The maximum diameters of acoustic neuroma ranged from 10 to 54 mm, and the average was 29.6 mm. The patients were classified into four groups; small type (<15mm) 9 patients, medial type (16-30mm) 84 patients, large type (31-40mm) 51 patients and giant type (41mm-) 22 patients.**

### **Results**

**The abnormalities of ETT were showed in about 1/3 of all patients. The abnormalities of OKP were showed in about 1/3 of all patients. The abnormalities of both tests were showed in about 1/4. The results of ETT and OKP were showed strong correlation. The rate of abnormalities rose as the diameter became large in both tests. The results of the test after the operation were improved in about 2/3 of abnormal ETT patients and about 2/3 of abnormal OKP patients.**

### **Conclusion**

**ETT and OKP were useful for evaluating the function of the cerebellum and the brain stem of acoustic neuroma patients.**

## **The influence of long term 4G hypergravity in vestibular system**

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**Introduction:** The fact that benign paroxysmal positional vertigo is caused by otolithic organ and it is an undeniable fact. Otolithic organ is developed during embryonic stage and has lifetime maintenance. However, there have been insufficient further studies on how the stable otoconia is liberated and causing BPPV. Therefore, using hypergravity to arouse the modification of otoconia on small experiment animals has been considered. However, due to the technical confines the maximum achievable hypergravity was 2.5G. Thus, we set priority on researching the hypergravity (>2.5G) influence on semicircular canal.

**Method:** We observed the ICR mouse (n=10, aged 8-10 weeks, weighing 18-25 g, Narabio tec.) on 4G condition for 2 weeks by remote observation method. The evaluation of vestibular function was measured by OVAR on 0.04, 0.08, 0.16, 0.32Hz cycle on 100% peak velocity. Furthermore, we tilt the axis for 30° and rotated over 10 cycles to cause step velocity stimulation. From the achieved nystagmus data we made 3D analysis

**Result:** The stimulated mice (under 4G for 2 weeks) have gained horizontal nystagmus data was  $0.211 \pm 0.125$ ,  $0.572 \pm 0.097$ ,  $0.649 \pm 0.083$ ,  $0.718 \pm 0.087$  under 0.04 - 0.08 - 0.16 - 0.32Hz conditions respectively. Those of vertical nystagmus was  $0.958 \pm 0.455$ ,  $0.849 \pm 0.403$ ,  $0.800 \pm 0.257$ ,  $0.831 \pm 0.198$ . The per-rotatory Tc of OVAR data was  $5.7 \pm 2.238$ s which is reduced compare with the achievable data from healthy normal mice ( $p < 0.001$ ).

**Conclusion:** By observing above data we can induce the result that the 4G hypergravity stimulation cause the modification not only on the otolithic organ but also on the function of semicircular canals.

## The role of non-invasive camera technology for gait analysis in patients with vestibular disorders

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### Purpose of study

Current balance assessments performed in clinical settings do not provide objective measurements of gait. Further, objective gait analysis typically requires expensive, large and dedicated laboratory facilities. The aim of this pilot study was to develop and assess a low-cost, non-invasive camera technology for gait analysis, to assist the clinical assessment of patients with vestibular disorders.

### Materials and methods used

This is a prospective, case-controlled study that was developed jointly by the local Neurotology Department and the Centre for Sports Engineering Research. Eligible participants were approached and recruited at the local Neurotology Clinic. The gait assessment included two repetitions of a straight 7-metre walk. The gait analysis system, comprised of a camera (P3215-V, Axis Communications, Sweden) and analysis software was installed in an appropriately sized clinic room. Parameters extruded were walking velocity, step velocity, step length, cadence and step count per meter. The effect sizes (ESB) were calculated using the MatLab and were considered large, medium or small if  $>0.8$ ,  $0.5$  and  $0.2$  respectively. This study was granted ethical approval by the Coventry and Warwickshire Research Ethics Committee (15/WM/0448).

### Results

Six patients with vestibular dysfunction (P group) and six age-matched healthy volunteers (V group) were recruited in this study. The average velocity of gait for P group was  $1189.1 \pm 69.0$  mm·s<sup>-1</sup> whereas for V group it was  $1351.4 \pm 179.2$  mm·s<sup>-1</sup>, (ESB: -0.91). The mean step velocities were  $1353.1 \pm 591.8$  mm·s<sup>-1</sup> and  $1434.0 \pm 396.5$  mm·s<sup>-1</sup> for P and V groups respectively (ESB: -0.20). The average cadence was  $2.3 \pm 0.9$  Hz and  $2.0 \pm 0.5$  Hz for P and V groups respectively (ESB: 0.60). The mean step length was  $620.5 \pm 150.7$  mm for the P group and  $728.5 \pm 86.0$  mm for the V group (ESB = -1.26). The average step count per meter was  $1.7 \pm 0.3$  and  $1.4 \pm 0.1$  for P and V groups respectively (ESB = 3.38).

### Conclusion

This pilot study used a low-cost, non-invasive camera technology to identify changes in gait characteristics. Further, gait measurements were obtained without the application of markers or sensors to patients (i.e. non-invasive), thus allowing current, clinical practice to be supplemented by objective measurement, with minimal procedural impact. Further work needs to be undertaken to refine the device and produce normative data. In the future, similar technologies could be used in the community setting, providing an excellent diagnostic and monitoring tool for balance patients.



**The saccade system and the vestibuloocular system use the common semicircular canal coordinate.**

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Our previous study on the neural circuit for horizontal saccades showed that the shortest excitatory pathway from the superior colliculus (SC) to abducens motoneurons (MNs) was disynaptic via excitatory burst neurons (EBNs) in the paramedian pontine reticular formation (PPRF), whereas the shortest inhibitory pathway from the SC to abducens MNs was disynaptic via inhibitory burst neurons (IBNs) in the paramedian ponto-medullary reticular formation. However, the neural circuits for vertical saccades have been only poorly understood. Our recent study showed that trochlear MNs received disynaptic excitation from the SC via the Forel's field H (FFH) (the riMLF in monkeys) and disynaptic inhibition from the SC via the interstitial nucleus of Cajal (INC). Presence of IBNs had not been postulated in the vertical saccade system before, but our results indicated that neurons in the FFH and INC were considered to be the counterpart of EBNs and IBNs in the horizontal saccade system, respectively.

In the present study, we analyzed input-output organization of last-order premotor neurons in the INC that receive inputs from the SC and project to MNs related to downward and upward eye movements, using intracellular recording technique in anesthetized cats. Premotor neurons in the INC that projected contralaterally to either downward or upward vertical MNs received monosynaptic excitation from the ipsilateral SC and disynaptic inhibition from the contralateral SC via the contralateral INC. Single INC neurons usually projected simultaneously to the FFH, INC and vertical MNs on the contralateral side. Therefore, the mutual inhibition is present between the upward saccade system on one side and the downward saccade system on the opposite side via inhibitory INC neurons. This pattern of mutual inhibition is very similar to that known in the vestibuloocular system, since the anterior semicircular canal system on one side is inhibited by the posterior semicircular canal system on the opposite side. These findings indicate that both the saccadic eye movement system and the vestibuloocular system use the common semicircular canal coordinate system.

## **The secondary phase nystagmus without head position changes**

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**Reversal of initial positioning nystagmus (the secondary phase nystagmus) without head position changes is rare to see in clinical. Two patients with the secondary phase nystagmus were seen in Tokyo Medical University Hospital.**

**Case 1: 59 years old female. She felt the left hearing loss and vertigo. At first, the leftward direction-fixed gaze nystagmus was found. Then, 10 days later, the leftward positional nystagmus (first phase) was seen on head turning to left side while supine, which was followed the rightward nystagmus (second phase) without head position changes. The first phase was thought to due to the left lateral semicircular canal type BPPV. The second phase was thought to due to the left inner ear dysfunction, because she felt no vertigo during the second phase.**

**Case 2: 43 years old female. She felt the vertigo whenever she rolled over to the right. The rightward strong nystagmus was seen on head turning to right side while supine, which was followed the leftward nystagmus without head position changes. The first phase was thought to due to the right lateral semicircular canal type BPPV. The second phase was thought to due to the left vestibular compensation. It seemed the term of secondary phase was too long as the vestibular compensation. We thought that there was some latent inner ear dysfunction, though there was no inner ear dysfunction in tests.**

**The first phase was due to BPPV in both cases. And the second phase was covered with the first phase in case 1, and was induced by the first phase in case 2.**

**The direction of nystagmus can be reversed without head position changes, which was thought to due to the correlation between the BPPV and inner ear dysfunction.**

**The skull vibration induced nystagmus test in cochlear-implanted patients: a prospective study in 51 patients**

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**Objectives:** To evaluate the benefit of the skull vibration-induced nystagmus test to diagnose vestibular disorders in cochlear implantation.

**Setting:** Prospective monocentric study in the French cochlear implant center of the Alps, between January 2014 and January 2016 in 51 patients who received a cochlear implant.

**Methods:** The vestibular function was studied with SVINT (skull vibration-induced nystagmus test) and compared with vestibular evoked myogenic potential (VEMP), caloric testing (CT) and questionnaires (Abbreviated Profile of Hearing Aid Benefit, Glasgow Benefit Inventory, Dizziness Handicap Inventory) results. Patients with inner ear malformations and preoperative dizziness were excluded from the study. The surgery consisted of the insertion of the electrodes through a round window niche.

**Results:** Before surgery, SVINT was positive in 11 (22%) patients and remained so after surgery. Three additional patients had positive SVINT after surgery making a total of 14 (27%) patients. In pre-operative assessment, 21 (41%) had VEMP bilaterally and, after surgery, 11 (24%) had VEMP bilaterally. Concerning CT, preoperatively, 36 (71%) cases had normal test and after surgery, 24 (47%) patients had normal CT on both sides. For SVINT, sensitivity was 67% and specificity was 98% before surgery. After surgery, sensitivity was 52% and specificity was 100%.

**Conclusion:** The SVINT is a rapid, non-invasive test and is complementary to other tests in detecting vestibular disorders after cochlear implantation.

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## **Vestibular function in healthy adolescents**

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### **Introduction:**

**Complaints of vertigo and dizziness in school-aged children and adolescents are not uncommon. Studies have reported prevalence ranging from 5.7-15%. Caloric test and rotatory chairs are often used for the evaluation of vestibular function in children and adolescents. Newer tests such as platform posturography, ocular end cervical Vestibular-Evoked Myogenic Potential (oVEMP and cVEMP), Video Head Impulse test (vHIT) and the new Suppression Head Impulse Paradigm (SHIMP) could prove to be more eligible and child-friendly. However, age specific normative values are prerequisites for such diagnostic tests to identify pathogenic conditions. Normative data have been extensively researched for adults but are sparse in adolescents. The purpose of this study is to evaluate balance and vestibular function in 30 healthy adolescents with the newest battery of tests for vestibular function.**

### **Method:**

**A questionnaire regarding self-perceived balance, daily physical activity and development of motor skills was obtained from 30 healthy adolescents. Age-range 13-16 years. Vestibular function was evaluated by platform posturography, bone-conducted ocular oVEMP, short tone burst cVEMP, and vHIT including SHIMP.**

### **Results:**

**Data collection will be finished by March 2017. Results from all of the above mentioned vestibular tests are to be presented.**

### **Conclusion:**

**(Preliminary) Most of the conditions causing vertigo or dizziness in adolescents are treatable, but a correct diagnosis given in time is of the essence in order to avoid chronic illness. We found the vestibular tests to be feasible and reliable tools to evaluate vestibular function in healthy adolescents.**

## **Vestibular impairments and visuo-spatial dysfunction: Comparison of subjective and objective cognitive assessment in patients with bilateral vestibular loss.**

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**Studies that have investigated cognitive and emotional problems in patients with bilateral vestibular loss have typically used questionnaires, with these showing significant increased complaints compared to control participants (Smith et al., 2010). However, currently, no research has explored the specific link between these subjective complaints and objective cognitive assessments. In the present study, we compared patient’s subjective responses to questionnaires of Dizziness Handicap Inventory (Jacobson & Newman, 1990), Hospital Anxiety Depression Scale (Zigmond & Snaith, 1983), and Neuropsychological Vertigo Inventory (Lacroix et al. 2016) to an objective neuropsychological assessment battery. We tested 13 patients with bilateral vestibular loss and 13 age and sex matched controls on the same assessments. Data analyses were performed using between groups ANOVA, with various independent variables associated with the different measures. The results showed a clear difference between groups for the subjective measures, replicating previous research, and showing that vestibular patients present with more subjective cognitive complaints than matched controls. However, interestingly, results on the objective neuropsychological measures failed to show statistically significant effects. These preliminary results suggest that even if patients believe that they have reduced cognition caused by their vestibular deficits, it remains challenging to demonstrate the effects using simple (standard) objective cognitive measures. We discuss the mismatch in results in terms of cognitive specificity and complexity. We also propose that the objective measure may more likely show effects if combined with a dual task, adding strain to cognitive resources.**

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## **Videonystagmography (VNG) test protocol for Central Positional Vertigo diagnose**

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**Introduction:** Vestibular syndrome may occur all along the vestibular pathways from the peripheral labyrinth to the brain. The bilateral structure of the peripheral and central vestibular systems is the key to many of its functions and its disorders. Central positional syndromes are less common than peripheral positioning vertigo but represent a challenge in neurotology practice. Clinical examination of the vestibular system requires accurate evaluation of the patients for spontaneous nystagmus and also for abnormal provoked nystagmus. Positional nystagmus diagnoses in central vestibular disorders increased with the systematic use of videonystagmography (VNG). Central positional vertigo can interfere in daily activities of the patients. Positional test protocol with VNG is very important in diagnose and follow up of this disorder.

**Materials and Methods:** This study selected patients after the first exam with videonistagmoscopy. All of them had positional vertigo (triggered by and occurring after a change of head position) and were evaluated under VNG. They presented nystagmus that did not fullfield the criteria for peripheral disorders. Eye movements were recorded in darkness in the following positions (test protocol for Central Positional Vertigo): sitting with head upright, sitting with chin-to-chest position, lying, lying with the left and right ear down. Pathological nystagmus refers to nystagmus that was exclusively present after positioning, that changed direction after the patient had been brought from upright to a lying position or that showed a change of SPV (slow phase velocity) of 100% between the different head positions. Oculomotor tests (including Gaze, Saccade, Smooth Pursuit, Optokinetic testing) were also taken.

**Results:** Twenty patients with positional vertigo (triggered by and occurring after a change of head position) were evaluated under VNG and presented abnormal nystagmus with central characteristics during the exam. Four patients were male and sixteen were female. Eleven patients fulfilled the diagnostic criteria of vestibular migraine. All of patients had negative results in magnetic resonance imaging (MRI) and normal oculomotor tests.

**Conclusion:** Central Positional Vertigo is caused by lesions along the vestibular pathways in the brainstem although they had negative result in MRI. The VNG Positional Test protocol allows an easily evaluation of nystagmus and play a decisive role in the diagnosis of central positional syndrome. It can give an effective measure for diagnose and follow-up in these patients.

## Visual Vertigo: The role of customised vestibular physiotherapy and the prevalence of White Matter Abnormalities in brain imaging

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### Purpose of the study

The term “visual vertigo” was introduced to describe the visual over-reliance that certain patients developed following an insult of the vestibular system. Customized vestibular physiotherapy is thought to be the gold standard in managing these patients. Some recent studies have shown that white matter changes of the brain might delay recovery of these patients. The aim of this study was to assess the effects of customized graded therapy in patients’ quality of life and to quantify the white matter abnormalities in this cohort’s brain imaging.

### Materials and methods used

This is a retrospective, cohort study of 63 patients, who were referred to our Visual Vertigo clinic. A customized visual vertigo therapy protocol was used for all patients. The validated questionnaires that were used included the Situational Characteristics Questionnaire (SCQ), the Dizziness Handicap Inventory (DHI) and the Hospital Anxiety and Depression Scale (HADS). A review of the brain imaging MRI (T2 weighted and FLAIR sequences) of these patients was also performed to assess for white matter changes, which were graded using the Fazekas scale.

### Results

The mean pre-rehab score of the SCQ was 2.36 (SD: 0.67), while the mean post-rehab score was 1.95 (SD: 0.83) ( $p < 0.01$ ). Similarly, for the DHI, the mean pre-rehab score was 64.5 (SD: 8.87), and the post-rehab score 57.9 (SD: 7.54) ( $p < 0.05$ ). HADS scores were within normal limits throughout, although a non-significant improvement of the HADS-Anxiety subscale was noted. White matter changes were noted in 17.9% of the patients that were scanned ( $n=56$ ); their mean age was 50.5 years (age range: 20 to 85 years).

### Conclusion

Customised visual vertigo therapy helps to alleviate vestibular symptoms in individuals with dizziness provoked by visually challenging stimuli by using central mechanisms of neuroplasticity (adaptation, habituation and substitution). We found statistically significant improvement in patients’ quality of life and frequency of symptoms as shown by the DHI and SCQ questionnaires respectively. White matter changes were noted in some of our patients but were of uncertain significance.

## VOR gain in patients with Endolymphatic hydrops

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The head impulse test (HIT) is a clinical test comprising high acceleration, low amplitude head rotation, a bedside test to identify peripheral vestibular deficits. Deficit of the vestibulo-ocular reflex (VOR) may not be diagnosed because corrective saccades cannot always be detected by simple observation and naked eyes. The video head impulse test (vHIT) is a new objective test of dynamic semicircular canal (SCC) function and VOR gain.

**Objective:**

The purpose of this study is to show presence of high VOR gain in patients with endolymphatic hydrops.

Specifically, data were obtained for 100 patients with and without endolymphatic hydrops.

**Study Design:** The vHIT was administered to each participant. Participants were seated, wore video goggles, and instructed to maintain their gaze on a visual target located on a wall at a distance of 1 meter . A high-speed (250 Hz) video camera, an accelerometer and a gyro meter are embedded in the video goggles and recorded eye (right eye) and head movement. The examiner stood behind each participant and rotated their head in the horizontal plane in two directions (left and right) resulting in the stimulation of the left and right horizontal SCCs. Participants underwent a minimum of 20 head impulses in each direction.

The significant effect of SCC (right horizontal SCC versus left horizontal SCC) on VOR gain is likely to be clinically relevant as the average VOR gain for the right and left horizontal SCCs was increased in patients diagnosed with endolymphatic hydrops based on clinical presentation and electrocochleography respectively.

**Results and Conclusion:**

Comparing these two groups, the patients with hydrops show statistically significantly higher VOR gain compared to the patients without hydrops.

Combination of video head impulse testing and EcochG results may prove helpful in the diagnosis of Ménière's disease.



**EQ-R-01**

## **Altered vestibular cortex functional connectivity at rest in vestibular neuritis**

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**Vestibular neuritis (VN) is a sudden unilateral vestibular failure. Recently, right hemispheric parietal operculum 2 (area OP2) has been suggested as core region for vestibular processing observed by the meta-analysis. In this study, we used resting state (RS-) fMRI to examine change in functional connectivity for central compensation with functional recovery in unilateral VN patients.**

**Sixteen patients (M:F = 9:7; mean age of  $43.7 \pm 16.8$ ) who were diagnosed as unilateral VN were included in this study (left:right = 7:9). Brain MRI(T1 and RS-fMRI) and clinical observation were performed within 2 days of diagnosis of acute VN and repeated at 2-3 months later (follow-up). Caloric test was performed and Korean version of the dizziness handicap Inventory (K-DHI) was collected at the time of MR imaging. Functional MR data was preprocessed with SPM12 software and seed-based analysis was performed to identify changes of RS- functional connectivity during recovery period using REST toolbox. Area OP2 in the right and the left hemispheres were selected as seed ROIs. Statistical threshold was set at  $p < 0.05$  (FDR-corrected).**

**We observed significantly increased connectivity with LOP2 after 3 months in vestibular network including the bilateral cingulate cortex, the right cerebellum, the right superior temporal gyrus (STG), the right OP3, the right precentral gyrus, the left insula and the visual cortices. K-DHI improvement was positively correlated with connectivity increase in the right STG, the right OP3, the right anterior cingulate gyrus and the middle cingulate gyrus.**

**The observed function connectivity alterations to networks of the fronto-temporal, visual, and cingulate cortex for LOP2 might be related to the disturbed connectivity to ROP2 due to acute peripheral vestibulopathy, leading to central compensation of functional recovery during the first 3 months after disease onset.**

## **ANATOMICAL VARIATIONS OF THE TEMPORAL BONE IN MÉNIÈRE'S DISEASE – A COMPUTED TOMOGRAPHIC STUDY**

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**INTRODUCTION:** Etiology of Ménière's disease (MD), a difficult-to-treat condition with high societal burden, remains controversial in the literature. The wide range of potential etiologic factors implicated in the onset of MD might explain the great variability in its clinical manifestations and natural history. The possible clinical and diagnostic impact of anatomical variations of the temporal bone among patients with MD has been recently studied.

**OBJECTIVES:** To identify potential anatomical variations of the temporal bone associated with the diagnosis of Ménière's disease. **MATERIALS AND METHODS:** 37 patients were included, although each ear was considered separately (n= 74). A case group (nA=33) was composed of affected ears of patients diagnosed clinically and audiometrically with definite Ménière's disease according to the most recent international reference sources. A matched control group (nB=41) was also used consisting of ears from individuals who did not meet criteria for MD and of contralateral ears from patients with unilateral disease. Standardized tomographic images from included individuals were submitted to a blinded and systematic evaluation regarding a broad variety of anatomical variations of the temporal bone. Obtained data were compared statistically between the groups and after stratifying the study sample. Significance level was set at 5%. **RESULTS:** Among affected ears, it was observed an increased number of tomographic scans in which the vestibular aqueduct could not be identified ( $p=0.01$ , Fisher's exact test). No statistically significant differences was observed when comparing the affected and contralateral ears from patients with unilateral Ménière's disease, between affected ears from patients with unilateral and bilateral disease or between contralateral ears of patients with unilateral affection and patients without MD. **CONCLUSION:** Some anatomical variations might be more frequent in the affected ears of patients with Ménière's disease. Nonetheless, physiopathological links between anatomic factors and MD remain uncertain.

## **Furosemide loading VEMP may confirm rupture of membranous labyrinth theory for Meniere's disease**

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**Purpose of the study:** We previously reported that the p13-n23 peak-to-peak amplitude in vestibular evoked myogenic potential (VEMP) increased after furosemide administration in the patients with Meniere's disease (Furosemide loading VEMP: F-VEMP). The recording procedures of VEMP have been developed since then. The first is tone-burst stimulation were used to record VEMP instead of click sound. The second is to neglect variability of muscular tonus, amplitude were evaluated after normalization by integrated EMG. We adjusted the examination to apply up-to-date clinical setting. We also studied the factors which affected the results.

**Materials and methods used:** Subjects were 25 cases with unilateral Meniere's disease who underwent F-VEMP. The peak-to-peak amplitudes of VEMP were recorded before (AB) and after (AA) 20mg of furosemide administration. The improved ratio (IR) was calculated by the following formula:  $IR = 100 \times (AA-AB)/AB$ . Tone burst sound stimuli of 105 dB SPL and 500Hz were delivered on an ipsilateral ear. The normalized amplitude was obtained from the raw amplitudes divided by the integral EMG value during 20msec before sound stimuli. According to the prior study, we defined the results as positive when  $IR > 22\%$ .

**Results:** The positive ratio was 63% on the affected ear of Meniere's disease, and 24% on the intact ear. The ratio was independent on their age, stage and duration of the disease. The ratio of the cases within 2 weeks after the attack was lower than those over 2 weeks after the attack.

**Conclusion:** Our result seems irrational. Furosemide increases the amplitude of VEMP by the diuretic effect for saccular hydrops on Meniere's disease. Schuknecht suggested that the contamination of perilymph with endolymph by rupture of membranous labyrinth result in the attack of Meniere's disease. Within a short period time after the attack, the rupture should still be existed thus the furosemide could not affect decreasing endolymph in the saccule. After the ruptured membrane repairs, the endolymph accumulate and the reformed hydrops should be decreased by the furosemide. Our interesting result supports the Shuknecht's rupture of membranous labyrinth theory.

## **Meniere's Disease: Molecular analysis of Aquaporins 2, 3 and Potassium Channel KCNE1 genes in Brazilian Patients**

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**Objectives:** Meniere's disease (MD) is a complex disease of unknown etiology characterized by a symptomatic tetrad of vertigo, hearing loss, tinnitus, and aural fullness. In addition to factors related to homeostasis of the inner ear, genetic factors have been implicated in its pathophysiology, including genes related to the transport of water and ionic composition maintenance of the endolymph, such as the aquaporin genes AQP2 and AQP3, and the potassium channel gene KCNE1. The aim of this study was to identify polymorphisms of these genes and determine their association with clinical characteristics of patients with MD. **Design:** A case-control genetic association study was carried out, including 30 patients with definite Meniere's disease and 30 healthy controls. The coding regions of the target genes were amplified from blood samples by polymerase chain reaction, followed by direct sequencing. The associations of polymorphisms with clinical characteristics were analyzed with logistic regression. **Results:** Five polymorphisms were identified: rs426496 in AQP2; rs591810 in AQP3; and rs1805127, rs1805128, and rs17173510 in KCNE1. After adjustment, rs426496 was significantly associated with tinnitus during the initial crisis and with altered electronystagmography, and rs1805127 was significantly associated with nephropathy. **Conclusions:** The genetic variant rs426496 in AQP2; rs591810 in AQP3 and rs1805127, rs1805128, and rs17173510, in KCNE1 were found in patients with Meniere's disease. The polymorphism rs426496, in AQP2, is associated with tinnitus during the initial crisis and altered electronystagmography. In addition, rs1805127, in KCNE1, is associated with the presence of nephropathy.

**EQ-R-05**

## **Otolin-1 in Biological fluids: a possible biomarker for Meniere`s Syndrome and other Inner ear diseases.**

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**Purpose of the study:** The expression of Otolin mRNA is highly restricted to the inner ear; in particular it is identified in support cells of the vestibular maculae and semi-circular canal cristae, it is also a component of the tectorial membrane. The aim of the study is to analyze the presence of Otolin-1 protein in serum, urine and saliva of patients suffering from Ménière's Disease and to verify its validity as a biological biomarker in the diagnosis of this disease.

**Materials and methods used:** The study involved 20 patients divided into two groups. A group of 10 subjects, mostly come in our department in emergency for vertigo crisis, already diagnosed with Ménière's disease according to the AAO-HNS criteria, with electrocochleography and glycerol-test positive. A second control group consisted of 10 subjects with negative current and past otoneurological medical history. The blood test, urine and saliva was done in the morning after patients have observed about 12 hours of fasting. The blood was collected into serum tubes, centrifuged at 1500g for 20 minutes; then the supernatant was collected. The samples were stored for a month in cold storage at -26 °C. The analysis of the samples was carried out through the use of ELISA-kit for OTOLIN-1.

**Results:** the results are still preliminary. Nevertheless the presence of Otolin-1 protein in all of the samples was shown so as a marked increase of protein levels for the three types of biological fluids analyzed in comparison with the controls.

**Conclusion:** a previous study showed that OTOLON-1 is already present in human serum. Our results indicate that Otolin-1 is also present in urine and saliva; this would allow to reduce the invasiveness of sample collection and increase the patient compliance. Very low levels of OTOLIN-1 are normally present in the serum, urine and saliva of healthy people; in literature has been described that in patients with vestibular diseases the blood levels of this protein are apparently raised from the norm. Therefore, high levels can also be found in patients with other pathologies such as BPPV. The hypothesis is that OTOLIN-1 would get rid in excess amounts, following a breakdown of the membranous labyrinth that occurs in Ménière's Syndrome. As well as with other biomarkers such as myoglobin, CK and troponin in cardiology Otolin-1 can be suitable as possible biomarker of this disease, according to the its possibile detection in urine and serum.

## The effects of oxygen-glucose deprivation on excitatory circuits in the vestibulo-cerebellum of the rat

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**Purpose of the study:** Posterior-circulation ischemia is one of the most common causes of vertigo in elderly patients, which is often diagnosed as Vertebrobasilar insufficiency (VBI). The excitatory circuit in the vestibulo-cerebellum is unique and different from other cerebellar regions, which is well involved in the central vestibular system. Unipolar brush cells are excitatory glutamatergic interneurons particularly enriched in the vestibulo-cerebellum, in which they are expected to play an important role in regulation of excitatory inputs. To clarify the vestibulo-cerebellar dysfunction in temporary ischemia, we examine the effects of oxygen-glucose deprivation (OGD) on unipolar brush cells (UBCs) and spontaneous excitatory postsynaptic currents (sEPSCs) in Purkinje cells in the vestibulo-cerebellum.

**Materials and methods:** Acute cerebellar slices were prepared from P20 to 28 rats. Spontaneous firing of UBCs and sEPSCs in Purkinje cells were recorded using current-clamp and voltage-clamp mode in whole-cell patch-clamp, respectively. To simulate OGD that occurs in ischemia, OGD external solution, in which O<sub>2</sub> and glucose were replaced by CO<sub>2</sub> and sucrose, respectively, was perfused instead of the normal external solution.

**Results:** Short-term OGD induced increases in spontaneous firing of UBCs, which was caused by membrane depolarization during OGD. This membrane depolarization of UBC during OGD was mediated by the persistent activation of NMDA receptors, suggesting that extracellular glutamate is accumulated under the ischemic condition. UBC firing indirectly affected Purkinje cells by altering parallel fiber inputs of a subset granule cells, resulting in a marked increase in spontaneous excitatory postsynaptic currents (sEPSCs) in Purkinje cells in vestibulo-cerebellar lobules IX-X. Interestingly, such an enhancement of sEPSCs in Purkinje cells during OGD was not prominent in lobules IV-VI, which have fewer UBCs. Similarly, the frequency and amplitude of sEPSCs in Purkinje cells were significantly greater in the vestibulo-cerebellar lobules IX-X than in other control vermal lobules IV-VI, even in control conditions.

**Conclusion:** The frequency and amplitude of sEPSCs in Purkinje cells were significantly greater in lobules IX-XI than IV-VI under the control condition, indicating that the Purkinje cells in the vestibulo-cerebellar lobules are more strongly activated by excitatory inputs than those in other lobules. UBCs play key roles in regulating local excitability in the granular layer, resulting in lobular heterogeneity in the susceptibility to OGD in the cerebellum. Such a susceptibility to ischemic insult in the vestibulo-cerebellum may provide a mechanism for the central vestibular dysfunction in VBI.

## Affecting factors on canalith repositioning procedures and recurrence in benign paroxysmal positional vertigo

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**Benign paroxysmal positional vertigo (BPPV) is most common vestibular disorder and its' treatment is well. Canalith repositioning procedure (CRP) is a standard treatment of BPPV, and provide rapid and long-lasting relief of symptoms of BPPV in most patients. Recently, patients requiring more than one treatment session are increasing gradually because of persistent symptoms or from the recurrence of symptoms after successful treatment. Therefore, we analyzed the affecting factors associated with the frequency of CRP and recurrence of BPPV.**

**METHODS: We retrospectively reviewed the clinical records of 1900 patients who were diagnosed as BPPV at the Dizziness Clinic in Soonchunhyang and Konyang University Hospital between 2009 and 2014. All BPPV patients were treated with repeated CRPs with or without Brandt-Daroff exercises. The clinical charts of these patients were reviewed with regard to gender ratio, incidence, causes, symptom duration, type or number of involved canal, frequency of CRPs, recurrence, and period of follow-up. Affecting factors associated with the number of CRPs were compared using Pearson's Chi-squared ( $\chi^2$ ) test and multiple linear regression analysis using dummy variables. In addition, stepwise logistic regression analysis was performed to compare recurrence by age, sex, causes, type and number of canal, symptom duration, and frequency of CRPs.**

**RESULTS: One thousand four hundred twenty-six patient (average age, 54.9 years; range 11-105 years) for whom follow-up information was obtainable were enrolled for the present study. The causes of BPPV were idiopathic (85.3%), trauma (7.9%), acute vestibular neuritis (5.5%), and sudden sensorineural hearing loss (1.3%). The variables influencing the increase in the frequency of CRP trials were the number and involved canal ( $\beta = 0.387$ ,  $p < 0.001$ ), the duration of vertigo before treatment ( $\beta = 0.326$ ,  $p < 0.001$ ), the type of involved canal ( $\beta = 0.130$ ,  $p < 0.001$ ), and age ( $\beta = 0.040$ ,  $p = 0.040$ ). Explanatory power of the regression model is 46.0% ( $F = 172.510$ ,  $p < 0.001$ ). Additionally, only the frequency of CRP was predicting factor on recurrence of BPPV and odd ratio was 1.205 (95% CI=1.078-1.346). The other variables associated with BPPV recurrence did not reach statistical significance.**

**CONCLUSIONS: Risk factors affecting on the frequency of CRPs are as follows: the number of involved canal, the duration of vertigo before treatment, the type of involved canal, and age older than 50 years. Potential risk factor that could cause BPPV recurrence is the frequency of CRP.**

## **Correlative Neuromodulation Therapy for the Elderly Cognitive Dizziness**

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**In elderly patients, dizziness and/or ataxia without localizing signs are often designated as "disequilibrium of the elderly", and this diagnosis is usually assigned to persons above the age of 65 in whom no specific cause of dizziness was identified.**

**There are 23 elderly patients of cognitive dizziness with or without acute vertigo episodes visiting our clinic in the past two years, and there are nothing particular found about their results of MRI, CAT, Hearing or Vestibular function tests at university hospitals or medical centers. But they feel persistent cognitive dizziness after treatment of medical centers for weeks or months.**

**We provide Correlative Neuromodulation Therapy(CNT) with the mid-frequency vector interfering pulse waves through the patch on the neuromodulation therapy sites over the face and the body, those which are correlative sympathetic nerve modulation pathways. Regulation of body functions by the autonomic nervous system is based on specific neuronal final autonomic pathways in the periphery and a specific organization of neural circuits connected to these pathways in the CNS.**

**Our patients received CNT without medication for their cognitive dizziness 50 minutes or more in every treatment, three times a week. The grade of dizziness decrease in the first 2 weeks and symptoms subsided 70-80% at the end of the first month.**

**The approach to the management of dizziness of non-localized cause in the elderly should be cautious and empirical. An arbitrary combination of sensory, central, and motor deficits is an adequate explanation for elderly cognitive dizziness. Most elderly do show some sensory or central nervous system to attribute ataxia or dizziness to lesions patients with cataracts, small infarction, minor sensory dysfunction, etc., but some are not. Psychosomatic model and Somato-psychic model ought to be considered. As a holistic perspective of treatment, CNT may be helpful to treat the elderly cognitive dizziness with or without empirical trials of medication, psychiatric consultation, and physical therapy.**



**EQ-T-03**

## **Description of vestibular nerve lesions after vestibular neurotomy and schwannoma resection**

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**Introduction :** Vestibular nerve lesions occur during Vestibular Schwannoma (VS) excision and Vestibular Neurotomy (VN) for Meniere's disease, inducing acute permanent total or partial vestibulo-ocular or vestibulo-spinal deficit. Vestibular compensation is the way of retrieving correct functions of stabilizing gaze and posture after acute or chronic vestibular lesions. Surgical vestibular lesions induced by surgery have been as fewly described as their impact on vestibular compensation.

**Objective :** Describe post-operative vestibulo-ocular and vestibulo-spinal fonctions after VS excision and VN for Meniere's disease.

**Material and methods :** Retrospective open study including surgical cases af SV and VN for Meniere's disease during 2 years in the ENT department of Assistance Public des Hôpitaux de Marseille. Vestibular investments were performed 1 day before and 7 days after surgery, including vestibulo-ocular explorations in low, medium and high speed (videonystagmography with caloric and pendular stimulation, video head impulse test VHIT from Synapsis®, France), static vestibulo-spinal explorations (P13N23 wave in vestibular electrophysiologic myogenic potentials VEMP) and dynamic vestibulo-spinal explorations (Multitest device from Framiral®, France).

**Resultats :** Fifty two patients were included : 45 SV and 7 VN. Fifty one percent of VS (n=23) were grade 3 in Koos classification. Only one patient reported normal vestibulo-ocular and vestibulo-spinal fonction after VS excision, and two patients had a complete vestibulo-ocular areflexia and vestibulo-spinal P13N23 wave abolition : 89,5% of patients exhibited partial lesions. Superior vestibular nerve lesions explored by caloric stimulation showed increase of ipsilateral hyporeflexia (64% to 89%,  $F(1,43)=21,94$  p0,05) but preponderance tripled (1,38 to 5,09%sec,  $F(1,40)=7,07$  p<0,0112). High speed stimulation showed a collapse of gain in ipsilateral anterior and horizontal canals (respectively 0,8 to 0,45  $F(1,20)=22,80$  p<0,0001 and 0,62 to 0,29  $F(1,21)=18,82$  p0,05) and P13N23 wave was preserved in 50% of patients. Conservation of P13N23 wave was associated to 46% of normoreactive posterior canals.

**Conclusion :** These results imply that residual vestibular functions remain after VS excision and VN for Meniere's disease. In spite of previous anatomical description, it seems that inferior vestibular nerve was never selectively deafferented and that saccular and posterior ampullar nerves should be considered as independant surgical entities. Residual post-operative vestibular fonction is frequent after surgical vestibular deafferentation. Its role in central compensation of gaze (vestibulo-ocular reflex) and posture (vestibulo-spinal reflex) should be investigated in a prospective study in order to improve post-operative central compensation.

## EQ-T-04

### Dose Effect of Intratympanic Dexamethasone for Meniere's Disease

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#### Purpose of the study:

Intratympanic (IT) injection of an aqueous solution of dexamethasone (DEX) has been used for the treatment of Meniere's disease for more than 25 years. However, the optimal dose for this treatment has not been defined. This study compared outcomes in patients with active Meniere's disease treated with IT DEX at a concentration of 10 mg/mL or 24 mg/mL.

#### Materials and Methods Used:

This was a retrospective case series in a tertiary referral center. Sixty-two patients diagnosed with active definite Meniere's disease with poor vertigo control despite medical therapy were included. Patients received a single IT injection with an aqueous DEX solution at a concentration of either 10 mg/mL (n=35) or 24 mg/mL (n=27).

The main outcome measure was duration of favorable control of symptoms, defined as the interval between the IT DEX injection and initiation of another intervention meant to treat active Meniere's. In other words, treatment failure occurred when there was any escalation of medical therapy, repeat IT injection, or surgical procedure for Meniere's.

#### Results:

Kaplan-Meier time to event analysis revealed duration of control of symptoms was significantly greater with 24 mg/mL than 10 mg/mL ( $p=0.0173$ , log-rank test). The median time to failure was 2.1 months for 10 mg/mL and 6.1 months for 24 mg/mL. 29.6% of patients treated with the higher concentration had greater than one year of good symptom control, compared to 5.7% for 10 mg/mL. Cox proportional hazards modeling revealed IT DEX concentration and duration of Meniere's disease were both independent predictors of duration of control after IT DEX. In the multivariate model, the hazard ratio for failure with 10 mg/mL was 2.736 (95% confidence interval [CI] 1.485 to 5.041,  $p=0.0012$ ). The hazard ratio per decade of presence of Meniere's symptoms was 1.504 (95% CI 1.071 to 2.110,  $p=0.0184$ ).

#### Conclusions:

IT DEX at 24 mg/mL results in significantly longer duration of control of Meniere's disease compared to 10 mg/mL. Patients with a long history of Meniere's symptoms are likely to fail IT DEX earlier than those with more recent onset. The finding of a dose effect provides evidence for the efficacy of this treatment. A prospective randomized trial is warranted to confirm the optimal dose.

**EQ-T-05**

## **EFFECT OF SUSTAINED-RELEASE FORM OF 4-AMINOPYRIDINE (FAMPRIDINE) ON PATIENTS WITH DOWN-BEATING NYSTAGMUS**

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### **OBJECTIVE:**

To describe the effect of sustained-release form of 4-aminopyridine (Fampyra®) on postural gait and oculomotor response in a population of patients with down-beating nystagmus.

### **METHODS:**

We included 8 patients with down beating nystagmus. 5 patients with cerebellar ataxia, peripheral neuropathy and bilateral vestibular arreflexia syndrome (CANVAS), 2 down-beating syndrome and a Multiple Sclerosis patient.

The 8 patients were treated with 10 mg of 4-aminopyridine, orally twice a day.

Nystagmus slow phase velocity with and without visual fixation, slow pursuit and VOR suppression were analysed in every patient before the inclusion in our protocol and in the 1 and 2 months of follow up. Postural imbalance was studied with a computerized dynamic posturography (Neurocom®) before and after treatment.

An analogical visual scale was performed in every patient before and after treatment to describe the subjective perception of their imbalance.

### **RESULTS:**

No side effects was described in any patient after 2 months of follow up. No significant differences were observed in the down beating nystagmus slow phase velocity between the baseline, 1 and 2-month determinations ( $p>0.05$ ). No significant differences were observed neither in the slow pursuit nor in the VOR suppression. Finally no significant differences were observed in the posturographic scores ( $p>0.05$ ). Only 2 of the 8 patients had a significant decrease of nystagmus slow phase velocity.

### **CONCLUSION:**

The sustained-release form of 4-aminopyridine was not effective in controlling the down beating nystagmus and postural imbalance in the global population after two months of treatment.

Nevertheless two patients of the total population studied underwent an improvement on their previous imbalance with a significant decrease of nystagmus slow phase velocity.

Further investigations should address in this issue.

**EQ-T-06**

## **Functional gait assessment as an objective metric for outcome after cartilage cap resurfacing for superior canal dehiscence**

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**Purpose:** Most current reports of postoperative outcome are subjective and vaguely defined. The Functional Gait Assessment (FGA) is an objective, standardized, age-normed, and validated metric of walking and ambulation. The FGA scale ranges for 0 - 30. The objective of this study is to measure the FGA, preoperatively and postoperatively, of patients undergoing cartilage cap resurfacing surgery.

**Methods:** Prospective, non-randomized, controlled study. 21 patients who underwent cartilage cap resurfacing surgery had a preop baseline FGA and a postop FGA at 3 months or later. 11 patients with superior canal dehiscence who did not undergo surgery had a baseline FGA as controls.

**Results:** For the surgical group, preoperatively 18/21 (86%) had FGA score below their age based norm, with a mean preop score of 23.7 (18.2 - 28.0). Postoperatively, 16 (76%) patients improved their FGA score to age-based norm. 4 remained within their preop age-based norm, and 1 had no improvement. 13 of the 16 that improved reached the maximum norm score of 29 or 30.

For the control group, 5/11 (45%) had FGA score below their age based norm, with a mean score of 24.2 (23.2 - 29.6).

**Conclusion:** An objective metric of outcome has clear advantages to subjective self-reports. This study demonstrates that although the surgical patients had poorer baseline scores compared to the controls, they demonstrated significant improvement postoperatively in walking and ambulation, with most reaching the maximum score attainable. The objective assessment of ambulation, as a reflection of dizziness, in patients with superior canal dehiscence, improved significantly after cartilage cap resurfacing surgery.

**EQ-T-07**

## **Long term effects of noisy galvanic vestibular stimulation on body balance in elderly adults**

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**Purpose:** Vestibular dysfunction causes postural instability, which is prevalent in the elderly. We previously showed that an imperceptible level of noisy galvanic vestibular stimulation (nGVS) can improve postural stability in patients with bilateral vestibulopathy during the stimulus presumably by enhancing vestibular information processing. In the present study, we sought to investigate the after-effects of an imperceptible long-duration nGVS on body balance in elderly adults.

**Materials and Methods:** Thirty elderly participants underwent two nGVS sessions in a randomized order. In Session 1, participants received nGVS for 30 min twice at a 4-h interval. In Session 2, participants received nGVS for 3 h. Two-legged stance tasks were performed with eyes closed while standing on the foam rubber surface, with and without nGVS, and parameters related to postural stability were measured using posturography.

**Result:** In both sessions, the postural stability was markedly improved for more than 2 h after the cessation of the stimulus and tended to decrease thereafter. The second stimulation in Session 1 caused a moderate additional improvement in body balance and promoted the sustainability of the improvement.

**Conclusion:** nGVS can lead to a postural stability improvement in elderly adults that lasts for several hours after the cessation of the stimulus, probably via vestibular neuroplasticity.

**EQ-T-08**

**MANAGEMENT OF THE ANTERIOR CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO WITH YACOVINO MANEUVER. TWO CASES REPORT.**

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**Purpose:** Benign paroxysmal positional vertigo (BPPV) is the most common cause of vertigo, and represents 1% of all patient visits to neurologists and ear, nose, and throat specialists. Anterior-canal BPPV (AC-BPPV) is considered the rarest form of semicircular canalolithiasis, with a postulated frequency of 1–2%. The aim of this study is to present two cases with anterior-canal benign paroxysmal positional vertigo (AC-BPPV) treated with Yacovino repositioning maneuver.

**Material-methods:** Two patients were diagnosed as AC-BPPV from January 2014 to January 2015. Both patients were treated with Yacovino repositioning maneuver and the efficacy of the method were evaluated by Dix-Halpike tests.

**Results:** The present data indicate that AC-BPPV is an uncommon variant of BPPV and can be treated safely and effectively. One patient was successfully controlled by the first maneuver and the other one was treated after one month follow up.

**Conclusions:** Interest in this particular form of BPPV is relatively recent, since no relevant studies have been reported prior to 1996. Most case series applied the Epley (or reverse Epley) maneuver, some authors used self-invented maneuvers, and others applied the Yacovino maneuver. AC-BPPV patients can be treated with Yacovino repositioning maneuver but multicenter controlled trials are needed in order to develop evidence-based guidelines for the treatment of AC-BPPV.

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**EQ-T-09**

**New bone formation over dehiscent superior semicircular canals after cartilage cap resurfacing surgery**

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**Purpose:** Cartilage, conchal or tragal, is used to resurface a dehiscent superior canal through a transmastoid approach. Cartilage is used because it is pliable enough to conform to the arcuate eminence, yet rigid enough to not prolapse and occlude the canal. Previously, the fate of the cartilage was unknown. The purpose of this study was to determine if the cartilage would calcify or stimulate new bone formation. The primary goal of this study was to assess, by computerized tomography (CT scan), possible new bone formation at the site of the cartilage cap.

**Method:** Blinded, controlled, retrospective review. High resolution CT scans of 20 patients were reviewed by two neuroradiologists. Of these 20, 6 had undergone transmastoid cartilage cap resurfacing, with both preop and postop CT scans. The other 14 patients had CT scans as part of the evaluation for dehiscence. All scans were deidentified, images cropped to eliminate evidence of previous surgery, with both Poschl and Stenver views used. The sequence of image sets were randomized, and the results of the interpretation were unknown to the two neuroradiologists. The outcome metric was the presence or absence of a dehiscence.

**Results:** There were 4 patients with a dehiscent superior canal who had new bone formation after cartilage cap resurfacing. One patient who had surgery had evidence of new bone formation adjacent to the dehiscence. There was agreement in all cases, including controls, of the presence or absence of bone formation. The time interval between surgery and bone formation ranged from 23 - 39 months, average of 31.6 months. Since the conclusion of the initial data collection, 6 additional patients have been identified with new bone formation, for a total of 10.

**Conclusion:** There is CT evidence of new bone formation following placement of conchal or tragal cartilage as a cap for resurfacing of superior canal dehiscence. In essence, the evidence suggests the dehiscence closes. This finding has potential significant implications for management of dehiscent superior semicircular canals.

## **Posterior Semicircular Canal Dehiscence: analysis of seven cases**

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### **Introduction and objective:**

**Semicircular canal dehiscence (SCD), first identified in the superior canal, has been also described in the posterior canal bearing a similar presentation. The incidence of posterior semicircular canal dehiscence has been estimated to be 0.2% in cadaveric specimens and 1.2% by CT scan . Diagnosis is difficult as SCD can be asymptomatic. Furthermore, this is complicated by the fact that many of its symptoms are common to more frequently encountered etiologies.**

**Our objective is to identify clinical, audiological and vestibular characteristics of posterior semicircular canal dehiscence.**

### **Patients and methods:**

**Seven patients aged 40 to 62 years, were identified with posterior semicircular canal dehiscence. Patients were identified by suspicious clinical history and examination. The diagnosis was confirmed by magnetic resonance imaging.**

### **Results:**

**Patients ranged in age from 43 to 61 years (mean, 50 yr). There were 4 males and 3 females. Only 1 patient had bilateral posterior semicircular canal dehiscence, resulting in 5 right ears and 3 left ears for the study.**

**All patients presented with both vestibular and auditory complaints. All of them had Vertigo with pulsatile tinnitus or autophony and hearing loss. In 2 cases, the symptoms were reported as consequence of valsava maneuver. All patients had a normal completed tympan in otoscopy.**

**Regarding hearing loss, the audiograms showed a purely sensorineural hearing loss in 4 cases and mixed hearing loss in the other cases. Electronystagmography showed an inferior nystagmus revealed by Head shaking test in 3 cases, a right preponderance in 2 cases and inferior preponderance in 2 cases.**

**All patients underwent magnetic resonance imaging. The dehiscence was identified into the cephalic portion of the posterior canal into the posterior cranial fossa in all cases.**

**No treatment of the lesion was recommended for any patient. They were all referred for possible amplification.**

### **Conclusion:**

**Posterior Semicircular canal dehiscence is an important entity often presenting with symptoms of dizziness or pressure induced vertigo, autophony, aural fullness and conductive hearing loss. Due to its varied presentation and mimic of other otologic conditions, its consideration is of increased importance.**



## EQ-T-11

### Postural benefice of early and intensive vestibular rehabilitation after surgical vestibular deafferentation

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**Introduction :** Vestibular nerve lesions occur during Vestibular Schwannoma excision and Vestibular Neurotomy for Meniere's disease, inducing acute permanent vestibular deficit in an already deficient vestibule. Vestibular compensation and rehabilitation is the way of retrieving correct fonctions of stabilizing gaze and posture after acute or chronic vestibular lesion.

**Objective :** Show the impact of post-operative early and intensive VR after VS excision and VN on the ability of patients to retrieve effective balance fonctions with minimal visual dependance.

**Material and methods :** Retrospective open study including surgical cases af SV and VN for Meniere's disease during 2 years in the ENT department of Assistance Public des Hôpitaux de Marseille. After surgery, patients underwent early VR with a specialized physiotherapist (SP). VR rythme was either regular (« Regular group », patient is sent once or twice a week to a liberal SP) or intensive (« Intensive Group », patient is sent in a rehabilitation center for 2 weeks and then to a liberal SP for regular rehabilitation). Posturographic evlauation was performed before surgery, 7 days and 2 months after surgery with a Multitest device from Framiral®, France. After VR, patients fullfiled a quality of life questionnaire Dizziness Handicap Inventory (DHI).

**Results :** Fifty two patients (45 SV and 7 VN) were included and openly distributed between the Regular Group (n=22) and the Intensive Group (n=30). After reeducation, under optokinetic stimulation, diminution of IIP after VR was greater in the Regular Group ( $p = 0,0268$ ) whereas diminution of power was greater in the Intensive Group ( $p = 0,043$ ). Optokinetic stimulation under dynamic conditions of balance showed a significant reduction of falls after RV in both the Regular Group ( $p = 0,007$ ) and the Intensive Group ( $p = 0,000002$ ), and in the sub-population of patients that did not exhibit postural compensation before surgery if post-operative VR was intensive ( $p = 0,04$ ). Each group showed stable DHI scores after VR compared to intra-individual pre-operative score.

**Conclusion :** Early and intensive post-operative VR after VS of VN promotes central compensation of posture by improving posturographic skills under static and dynamic conditions of balance, espacially in patients who do not exhibit full pre-operative compensation of vestibular deficit.

**Therapeutic effects of ethyl loflazepate and diphenidol on self-assessment of handicap in daily life due to vertigo in patients with vertigo associated with severe anxiety**

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**Vertigo and dizziness are mainly caused by dysfunction of peripheral and/or central vestibular systems. However, psychiatric disorders such as anxiety sometimes also cause vertigo and dizziness. Alternatively, the stress due to vestibular dysfunction may initiate subsequent development of psychiatric disorders such as anxiety and then lead to exacerbation of subjective vertigo and dizziness. If patients are diagnosed as having psychiatric disorders, it is necessary to treat not only vestibular dysfunction but also psychiatric disorders with adequate medication such as anti-anxiety drugs, and/or psychotherapy. In this study, we aimed to elucidate the role of ethyl loflazepate, one of benzodiazepines, in the treatment of chronic dizzy patients with severe anxiety. The present study includes 21 patients treated with ethyl loflazepate and 22 patients treated with difenidol hydrochloride, which is an anti-emetic and anti-vertigo drug, for 4 weeks. The anxiety state was evaluated by using State-Trait Anxiety Inventory (STAI), and treatment outcomes were measured with the self-assessment of handicaps in daily life caused by vertigo and dizziness using dizziness and unsteadiness questionnaire. The questionnaire consisted of five factors related to emotional or bodily dysfunction caused by dizziness. In patients with high STAI scores, ethyl loflazepate improved four of the five subjective handicap factors as well as the state anxiety inventory score at 4 weeks after the start of treatment. In the treatment of dizzy and anxiety patients, ethyl loflazepate is more effective at relieving subjective handicaps caused by dizziness, specifically, in factors of disturbance of social activity, emotion and interpersonal communications compared to difenidol hydrochloride.**

## **Vertigo Perception and Quality of Life in Patients after Surgical Treatment of Vestibular Schwannoma with Pretreatment Prehabilitation by Chemical Vestibular Ablation**

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### **Purpose of the study**

**Surgical removal of vestibular schwannoma causes acute vestibular symptoms, including postoperative vertigo and oscilopsia due to nystagmus. In general, the dominant symptom postoperatively is vertigo. Preoperative chemical vestibular ablation can reduce vestibular symptoms postoperatively. The presumption of prehabilitation is decreasing labyrinth function before surgery and allowing for faster compensation in postoperative time. In this poster, we present our experience of chemical vestibular prehabilitation, as evaluated by questionnaires.**

### **Materials and methods**

**We used 1.0 ml of 40 mg/ml nonbuffered gentamicin in three intratympanic installations over 2 days, 2 months preoperatively in 10 patients. Reduction of vestibular function was measured by the head impulse test and the caloric test. Reduction of vestibular function was found in all gentamicin patient groups. After gentamicin vestibular ablation, patients underwent home vestibular exercising for two months. The control group consisted of 10 patients who underwent only home vestibular training two months preoperatively. Postoperative rate of recovery and vertigo in both groups were evaluated with the Glasgow Benefit Inventory (GBI), the Glasgow Health Status Inventory (GHSI) and the Dizziness Handicap Inventory questionnaires, as well as survey of visual symptoms by specific questionnaire developed by us.**

### **Results**

**There were no statistically significant differences between both groups with regards to the results of questionnaires. Patients who received preoperative gentamicin were more resilient to optokinetic and optic flow stimulation ( $p < 0.05$ ).**

### **Conclusion**

**Results of this study left open some questions, which should be explored by future research: assessment of degree of visual dependency following surgery, detailed study of optokinetic response and smooth pursuit movements and its influence on the final compensation of vestibular deficit.**

## **Virtual Reality training in the treatment of vestibular system impairment.**

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**Purpose of the study: The aim of this study is to assess the effectiveness of Virtual Reality (VR) training in rehabilitation of patients suffering from vertigo, dizziness and balance instability.**

**Materials and Methods. Forty patients diagnosed in the Otolaryngology Department of the Medical University of Lodz, with vestibular system dysfunction were enrolled in the study. Patients medical history, otoneurological examination and videnystagmography (VNG) were conducted. The physiotherapeutic programme comprising of a 10 day course of exercises on a VR unit, combining a motion sensor and a posturography platform with visual feedback. Additionally, habituation exercises at home were introduced with a patients diary. Patient assessment included Dizziness Handicap Inventory (DHI), ABC questionnaires, and stabilometric measurements at baseline and 3 months after therapy. We compared the results of questionnaires and posturography platform readings**

**Results. After therapy patients demonstrated a decrease in the severity of symptoms under a subjective assessment. Statistically significant differences were found in ABC questionnaires, total DHI patients score ( $p < 0.005$ ) and 3 subscales: physical, emotional, functional ( $p < 0.05$ ). Sway area and sway length measured in different test decreased in this groups, although the results were not statistically significant.**

**Conclusions. Virtual Reality training is an effective tool in rehabilitating patients with vestibular system impairment.**

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