High-frequency testing of the vestibular system

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Summary

Currently, many patients with vestibular symptoms are still misdiagnosed or receive ineffective treatments. Since vestibular deficits are associated with a negative impact on quality of life and an increase in health care costs, improving care for vestibular disorders is essential. This can be facilitated by standardization of diagnostic tests, obtaining normative values for laboratory tests, and improving the knowledge, skills, and attitudes of individual clinicians and therapists. Therefore, this thesis investigated high-frequency vestibular testing, to gain more insights into the diagnostic process of vestibular disorders, more specifically bilateral vestibulopathy (BV).

One of the main functions of the vestibular system is image stabilization, which is facilitated by the Vestibulo-Ocular Reflex (VOR). VOR testing is the hallmark of vestibular testing of the semicircular canals. In **Chapter 2** it was determined whether wearing corrective spectacles causes clinically significant VOR changes during video head impulse testing (VHIT). No significant VOR changes were found. Therefore, no corrective measures are necessary when performing VHIT on subjects with a refractive error.

Chapter 3 demonstrated that different commercially available VHIT systems can result in different VOR outcomes in the same BV patients, leading (in some cases) to disagreement regarding BV diagnosis. Nevertheless, in the majority of the BV patients, the three VHIT systems were in agreement (83%). During VHIT, it remains important to not only assess VOR gain, but also the raw traces and compensatory saccades. Additionally, BV is diagnosed using a combination of symptoms and several vestibular tests (caloric test, rotatory chair test, and/or VHIT). Since these vestibular tests are complementary, only performing VHIT is not always enough to rule out BV.

When comparing Suppression Head Impulse testing (SHIMP) and Head Impulse testing (HIMP) in a large group of BV patients (**Chapter 4**), it was found that almost no covert saccades were produced during SHIMP testing, in contrast to HIMP testing. Moreover, VOR gain was lower during SHIMP testing. However, the clinical relevance of these differences was negligible, since both paradigms were able to detect BV in the vast majority of patients. Therefore, SHIMP testing in clinical practice seems to have little added value in addition to HIMP testing. Nevertheless, since SHIMP demonstrated to be a "covert saccade killer", SHIMP might be an alternative in clinical settings which do not have the financial means to obtain a VHIT system.

Chapter 5 compared the functional Head Impulse Test (fHIT) and the Dynamic Visual Acuity tested on a treadmill ($DVA_{treadmill}$) with the self-reported complaints of oscillopsia in BV patients (using the Oscillopsia Severity Questionnaire). It was illustrated that fHIT correlated

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better than $DVA_{treadmill}$ to subjectively reported oscillopsia, but this correlation was only moderate. Nonetheless, all BV patients were able to complete the fHIT, in contrast to $DVA_{treadmill}$. The findings of this study also implied that fHIT and $DVA_{treadmill}$ are complementary tests of the vestibular system since different stimuli and different parts of the vestibular system are involved.

Finally, to improve the diagnostic pathway in BV patients, it is imperative to standardize high-frequency diagnostic tests, which includes the development of a universal VOR gain calculation algorithm and assessment of the raw traces and corrective saccades. Furthermore, it should be investigated whether VHIT system-specific cut-off values to diagnose BV are a possibility to increase agreement between VHIT paradigms/systems.