Vestibular Lab Manual

Second Edition

Core Clinical Concepts in Audiology

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Second Edition

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Putting It All Together

Foreword to the First Edition

How can we make learning in audiology more effective? This is the question that we began with in the design of the Core Clinical Concepts in Audiology series. Our answer is revealed in the construction of the books of the series. Herein we seek to provide palatable and useful information to students and practitioners to develop and refine clinical skills for audiology practice.

By and large, texts available for our field provide exhaustive examination of broad topic areas. Whereas these texts are useful and necessary for advanced scholarship, we currently lack pedagogical materials that focus on basic clinical methods and knowledge. The books in this series are designed for teaching and learning.

These books are written for the student. The scope of practice for audiology has expanded dramatically since the inception of our field. Today's students must acquire a tremendous arsenal of clinical skills and knowledge in a very short period of time. The books of the CCC series are meant to be clear and comprehensible to students, focusing on the content necessary to achieve knowledge and skills for clinical practice. Furthermore, the books are designed to be economical, both financially and in the amount of time spent in learning.

These books are written for the clinician. With expansion of the scope of audiology practice, currently practicing clinicians must acquire new skill sets while continuing to serve their patients — not a small feat. Hard-working practitioners deserve educational materials compatible with the real-world demands of fast-paced and time-limited clinical practice. In response to these needs, the books of the CCC Series are designed to be concise. The succinct construction of the series is meant to allow readers to efficiently acquire the essential concepts and skills described in the books.

These books are written for the instructor. Most instructors of audiology courses are familiar with the frustration of searching for materials that cover the topics that reflect the learning outcomes of their courses. Especially lacking are materials that are designed to promote clinical learning. The books of the CCC series are designed to be focused on specific areas of clinical practice. They are targeted toward the learning outcomes commonly found in audiology curricula. Due to the economical nature of the books, instructors can feel comfortable in creatively combining different Core Concepts in Audiology books to support the unique and diverse learning demands of specific courses.

These books are written for the user. The needs of the reader are our primary concern. These books are written for the purpose of helping readers learn to be outstanding clinical audiologists. To be sure, these are lofty goals. The authors of the CCC series books have put forth their best efforts to accomplish these goals.

The *Vestibular Lab Manual, 2nd Edition* by Bre Myers serves as a practical learning tool for vestibular evaluation, an important component of the CCC series. Dr. Myers brings both her teaching and clinical skills together in the formulation of this volume.

The manual provides a review of all major areas of vestibular evaluation, including electronystagmography, videonystagmography, computerized dynamic posturography, rotational testing, VEMPs, and other tests. Dr. Myers provides a rational and detailed approach to learning to perform vestibular evaluation. Laboratory exercises are included to facilitate active learning of concepts. Case studies included in the manual allow the reader to apply diagnostic results to develop and strengthen clinical problem-solving and interpretation skills. This manual is not only of great value to the student of audiology, but also provides an excellent refresher for practicing clinicians.

The organization and construction of the book works to achieve the goals of the CCC series, providing information in a manner consistent with the needs of readers. We believe that this text will

provide the reader with a foundation of knowledge to implement and improve clinical skills in vestibular evaluation.

Kenneth R. Bouchard, PhD
Virginia Ramachandran, AuD

Preface

On the expo floor of the 2009 American Academy of Audiology annual conference, I searched publishers' booths for vestibular texts. I had been teaching at Salus University for the past year and was in need of ideas on how to connect the didactic and practical aspects of vestibular testing in a lab. In one booth, a kind man approached and asked if he could help me find something specific. I asked if they had any lab manuals for vestibular testing, something that was geared toward the technical performance of the testing, not necessarily the theoretical underpinnings. He pointed me to the vestibular science section, and I was surrounded by excellent texts, just not what I was looking for. I mentioned that I had created a few lab assignments but was hoping someone with more experience had better ideas. He laughed, handed me his card and said, "Why don't you send me what you have?" I looked at his card and realized that I just had the honor of speaking with Sadanand Singh, founder of Plural Publishing. As soon as I returned home, I sent my folder full of word documents to him. However, I did not hear anything in the months following and all but dismissed the encounter entirely until Ken Bouchard contacted me the following November. He said that Plural Publishing was interested in adding to their Core Clinical Concepts in Audiology series and would I be willing to flush out my "manuscript" into an actual manual? How could I say no? So, over the next year, between teaching, seeing patients, and taking care of a newborn, I worked on putting together the first edition. I may have even slept at some point that year, but it is hard to remember.

There are many excellent texts concerning vestibular and balance history, physiology, and diagnostic utility. The information found in these large textbooks is often the result of collaboration between many authors, with specialization in a particular area of vestibular and balance science. The depth at which concepts are explained allows for even the seasoned vestibular clinician to gain insight with every reread. The *Vestibular Lab Manual* is not one of those texts. The primary goal of this manual is to give practical guidance and confidence to students and clinicians in the vestibular lab. There are many moving parts to consider when evaluating the vestibular and balance systems of our patients. The *Vestibular Lab Manual* attempts to break down all of these parts into digestible nuggets of information. Most chapters are designed to engage students or clinicians in approximately an hour of focused, hands-on training on one particular aspect of testing with specific learning objectives, guided practice, review questions to reflect upon, and plenty of room for notes. In keeping with the spirit of deeper understanding that is required to be a competent clinician, specific chapters in other texts are cited for further reading and explanation.

The first edition covered evaluation techniques that were found in well-equipped vestibular labs in 2009. Since the first edition was published, there has been some expansion of clinically available tests in the vestibular lab, and the second edition includes new chapters that cover vHIT and oVEMPs. Also new to the second edition is a section covering well-established concepts in vestibular rehabilitation and canolith repositioning techniques. The second edition also provides some updated case studies, guidance on report writing approaches, and caveats. You may also observe that the title has changed from the *Vestibular Learning Manual* to *Vestibular Lab Manual* to more accurately classify the text's primary use as a guide to hands-on practice in a lab. Hopefully, some learning still happens, but the hope is that the lab manual supports what is being lectured, read, and studied prior to entering the lab. My students have remarked that the manual is like the *Cliff Notes* version of larger texts on the subject. It surely isn't a substitute, but it is an invaluable supplemental guide.

Acknowledgements

The second edition is dedicated once again to the students of the Osborne College of Audiology who continue to teach me. I would also like to thank Brad Stach, Angie Singh, and Valerie Johns for their humor and support over the years. Finally, to my family, for their love and patience.

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Video Head Impulse Test (vHIT)

INTRODUCTION

Video Head Impulse Testing (vHIT) is designed to evaluate the angular vestibular ocular reflex (VOR) in the horizontal (lateral), right-anterior left-posterior (RALP) and left-anterior right-posterior (LARP) planes at fast speeds. The origin of this test was derived from the Halmagyi head thrust bedside evaluation. See Chapter 9 for more details. Clinicians are now able to capture both overt and covert saccadic corrections due to the advancement of high-speed video recording techniques. They are also able to measure the gain of the VOR at velocities higher than previously achievable via the rotational chair.

LEARNING OUTCOMES

- Be able to properly place and calibrate vHIT goggles
- Properly elicit vHIT response in horizontal, RALP, and LARP planes.
- Interpret results accurately.

REVIEW OF CONCEPTS

We have learned in previous chapters that the VOR works over a range of head velocities. Caloric irrigations stimulate the VOR mediated by the horizontal canals at unnaturally slow speeds (0.002 to 0.003 Hz), and rotational chair evaluates the horizontal VOR during more natural head movements. The vHIT expands this range to include the upper limits of the VOR's capabilities.

Clinically, patients recovering from a peripheral vestibular injury will complain of blurred vision during quick head movements for several weeks or even months following an acute attack. The Halmagyi head thrust, described in Chapter 9, is a bedside evaluation used to observe overt saccadic corrections in those who may not be fully compensated. This bedside evaluation is reliant upon clinicians' visual observational skills and may miss those patients who display covert saccades. Covert saccades occur while the head is still in motion and can be recorded via high-speed video cameras. For a complete review of vHIT theory and clinical integration, the interested reader is directed to Curthoys et al. (2016) "The Video Head Impulse Test" in Jacobson and

Shepard's" (Eds.) *Balance Function Assessment and Management* (2nd ed).

Patient Setup

The setup for most systems is similar to those for VNG testing in that the patient is seated a standard distance away from a stationary target. The video-recording goggles are securely placed over the patients eyes. Once the goggles are correctly placed, the clinician must ensure that the tracking sensitivity is following the center of the pupil(s). Depending on your system, one or both eyes will be tracked. Calibration follows and is typically completed by having the patient's head remain still while his/her eyes follow a target.

There is a bit of a learning curve when it comes to delivering consistent head impulses in the various planes of recording. To begin, the author suggests practicing in the horizontal plane, as this is the most common plane of motion. Prior to delivering any impulses, the patient should be screened for any neck muscle or cervical spine injuries. Describe what you are going to do and verify with them that they will be capable of performing it without pain. If they do complain of discomfort during a test, either stop or modify your technique. Firmly grasp the patient's jaw and cheeks from behind so as not to obstruct their view of the target. Asked them to clench their teeth during the test to ensure their entire head is moving with your hands. Try not to touch the goggles or the strap itself as this may introduce noise into your results (Figure 14–1). Instruct your patient to keep focused on the target that is in front of them at all times. Tell them that you will be quickly moving their head left and right randomly. The movement itself should not be greater than 20 to 30 degrees off center. It is the quickness, not necessarily distance, which matters. Also, be sure to hold the patient's head in the left and/or right position at the end of the impulse for a second before slowly returning the patient's head to neutral position. Multiple trials per side and per plane are necessary to accurately surmise whether there is either a reduction of VOR gain and/or overt/covert saccades. The vertical canals are a bit trickier to master and require a slightly different technique. Some clinicians find that placing one hand on the top of a person head and one under the chin offers the most control (Figure 14–2). If you are testing the LARP plane, turn the patient's head approximately 30 to 45 degrees to the right. Ask them to maintain focus on the target as you quickly tilt their head downward-forward toward

A **B**

FIGURE 14–1. Photo of head and hand starting (**A**) and ending (**B**) position for horizontal canal testing.

the left ear and upward-backward toward the right ear. Testing the RALP plane requires the head to be turned 30 to 45 degrees to the left.

Interpreting Results

Velocity gain of the eyes during head movement is the primary objective measurement of interest, in addition to the subjective identification of overt and covert saccades (Figure 14–3). There are a few different methods that manufacturers use to quantify gain, and the reader is directed to their equipment manual for specifications. A study by Janky, Patterson, Shepard, Thomas, and Honaker (2017) suggests that comparison of gain measures between different equipment may not be appropriate due to the significant differences found in gain calculations. However, the study also found that gross classifications as gains identifying normal from abnormal were not significantly different across manufacturers.

Because we are testing at the higher levels of the VOR, we expect gain measure to be close to unity gain, meaning that compensatory eye speed should be equivalent to head speed through the vHIT recording. Clinical norms will need to be established, but generally, gains of 0.9 to 1.0 have been found in normal healthy individuals (see Figure 14–3).

In addition to the quantitative measure of gain, the clinician is also looking for qualitative

A B

FIGURE 14–2. Photo of head and hand starting (**A**) and ending (**B**) position for RALP plane testing.

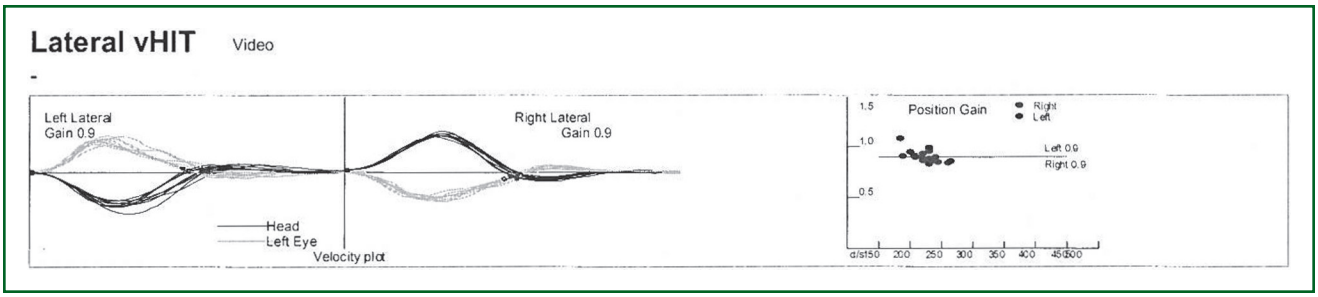

FIGURE 14–3. vHIT results showing a normal tracing.

evidence of saccadic corrections in the tracings. Saccadic corrections can occur either while the head is still in motion (covert saccades), or after the head stops (overt saccades). Overt saccades are seen shortly after an acute attack during vHIT measures, when head is moving towards the affected ear. Covert saccades can persist for weeks to months following an acute peripheral attack. However, both overt and covert saccades can be present in the same patient.

GUIDED PRACTICE

1. Properly position recording goggles on a volunteer and perform calibration.
2. Practice eliciting vHIT response in the horizontal plane multiple times in each direction until you achieve consistently acceptable recordings.
3. Practice eliciting vHIT responses in each of the vertical planes (RALP and LARP) multiple times until you achieve consistently acceptable recordings.
4. Review the analysis screen.

REFLECTION AND REVIEW

1. Please describe in detail the vHIT testing procedure. What is measured/observed during the test?

2. What is the difference between covert and overt saccades? What does the presence of covert and overt saccades indicate clinically?