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The Incidence of Positional Nystagmus in Healthy Participants Revisited

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An Audiology Doctoral Project submitted to the Faculty of the
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University of South Florida
in partial fulfillment of the requirements for the degree of

Doctor of Audiology

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(ABSTRACT)

The purpose of this study was to examine the prevalence of nystagmus found in healthy individuals during the positional testing subtest of the standard vestibular test battery. Positional testing involves moving the patient's head, and sometimes the entire body, into a variety of positions while observing eye movement. The hypothesis of the current study was that a relatively low percentage of participants would display nystagmus during positional testing used routinely in clinical diagnostic procedures. The findings were then compared to those of an earlier study in which 82% of normal, healthy individuals were reported to exhibit nystagmus during this testing.

Twenty-five participants were selected that had no known otologic disease and who reported normal hearing sensitivity. In addition, the participants affirmed they had not consumed any alcohol or taken any medications that are known to affect nystagmus. They were then observed in nine different positions. Forty-eight percent of the participants experienced nystagmus in at least one position. Although this percentage was considerably lower than that reported in the earlier study, methodological differences appear to account for the discrepancy. Specifically, the criterion for determining the presence/absence of nystagmus potentially explains the difference in full.

Introduction

The relationship between the vestibular system and oculomotor responses has been a subject of study for well over a hundred years. Cohen discusses the work of early research scientists Mach, Breuer, and Crum-Brown as being among the first researchers to formulate theories and publish information linking motion and perception (Cohen, 1984). From these early observations vestibular assessments have developed. Clinical vestibular assessment was documented by Robert Barany in the early twentieth century (Pappas, 1984). Barany researched and developed the underpinnings of current day vestibular assessment (Pappas, 1984). Current vestibular diagnostic tests include electronystagmography (ENG) or videonystagmography (VNG). These tests consist of three major subtests: ocular motor tests, positional and positioning tests and alternating binaural bithermal caloric irrigations of the ear. The current study is an investigation of the positional tests.

Both ENG and VNG techniques are used to determine if disorders of the vestibular system are present. The otolithic membrane and the cupula move with the head and are affected by the endolymphatic fluid, which surrounds them. The movement of the endolymph stimulates the hair cells by relative displacement of their cilia (Jacobson, Newman, & Kartush 1997). Normally, predictable reflexive oculomotor responses result from movement of the vestibular fluid. Controlled movement of vestibular fluid can be achieved by placement of the head and body in various positions, which provides clinically useful information.

Meyers (1929), was the first to use electro-oculography as a way to record some of these oculomotor responses. Mowrer (1935) identified an electrical difference, known as the corneoretinal potential, between the positively charged front, and negatively charged back of the eye. The corneoretinal potential allows for precise electrical measurements of the eye movements or electro-oculography. This potential can be measured with surface electrodes and form the bases for ENG recordings used today (Jacobson, Newman, & Kartush 1997). VNG also records eye movement with infrared cameras in specially designed goggles worn by the individual during testing. Both types of recording allow the examiner to visualize an individual's eye movement during many conditions of the exam.

Eye movements such as those described here are identified as nystagmus. Nystagmus is analyzed in terms of a slow phase eye movement followed by a fast phase eye movement in the opposite direction (Barber & Sharpe, 1988). The nystagmus is described as either right or left beating depending on the direction of the fast phase movement. Figure 1 shows an ENG tracing of left beating nystagmus.

Individuals with symptoms of vestibular disease are typically assessed by recording (ENG or VNG) and subsequently interpreting eye movements, including nystagmus. Such clinical assessments are used to diagnose vestibular disorders and diseases, which are identified as metric aberrations from clinically normal data sets. These clinical assessments have changed little since their original description by Barany in the early 1900's (Cohen, 1984), aside from the ability to record the nystagmus using ENG or VNG.

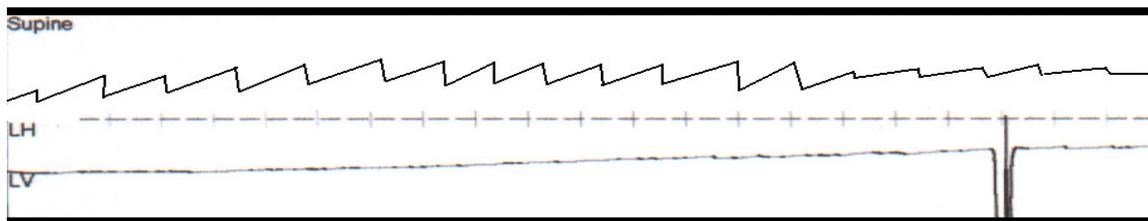


Figure 1. ENG tracing of left beating nystagmus.

One major subtest of ENG or VNG testing involves manipulation of the participant into a variety of different positions. The presence of position-induced nystagmus has long been used as a clinical indicator of unhealthy vestibular systems (Schuknecht, 1974). Should nystagmus occur during this phase of testing it is qualified as either positioning or positional nystagmus (Barber & Sharpe 1988). If nystagmus occurs while the head and body are in the process of being moved to a particular position, the nystagmus is called positioning nystagmus. If the head and body are held in a static position and nystagmus occurs it is termed positional nystagmus. Positional nystagmus, which is the focus of this investigation, may continue as long as the head and body are in the offending position. Positional nystagmus may be an indicator of many disorder types: peripheral, spinal, central and systemic disease (Barber & Sharpe 1988).

Previous reports indicate that clinicians should expect 82% of healthy individuals to experience nystagmus during positional testing (Barber and Wright, 1973; Barber and Stockwell, 1976). The significance of this finding is that when positional nystagmus is

observed in patients with vestibular complaints, it is difficult to interpret if the eye movements are the result of normal variation (the person is among the 82%) or if the nystagmus represents an underlying disorder.

In Barber and Wright (1973), nystagmus was considered present when three or more consecutive beats with recognizable slow and fast components were observed. Each recording was then assigned to one of four categories; no nystagmus; doubtful, possible nystagmus; doubtful, probable nystagmus, and unequivocal nystagmus. If the nystagmus continued for a duration of at least 30 seconds in any one position, it was reported as persistent nystagmus (PN). Any other degree of nystagmus was defined as intermittent nystagmus (IN). Direction-fixed nystagmus (DFN) was regarded as nystagmus that occurs in all positions and was of constant speed slow component. Only nystagmus that occurred in all positions and varied in speed of slow component in different positions was labeled positional. These findings are currently discussed in published manuals such as *The Handbook of Balance Function Testing* (Jacobson, Newman and Kartush, 1997).

Although this finding is seldom questioned in the literature, there are some potential factors in the investigation that make it difficult to generalize the results and interpretation to common clinical practice. Specifically, specialized test equipment was used in the Barber and Wright study. A motor-driven examination table was used throughout the positional testing and this table allowed the tester to move each participant's head, neck and body as one unit, allowing for minimal neck flexion. In addition to a reduced neck flexion, the specialized table controlled movement from one lateral position to another at a rate of about 9° per second and moved the participant to neutral positions at a rate of 4° per second (Barber & Wright, 1973). The specialized table utilized in Barber and Wright (1973) is not used during current clinical testing of individuals with symptoms of vestibular disorders. Therefore, interpretation of clinical findings obtained with common technology using normative data obtained with specialized equipment may lead to inappropriate diagnosis and subsequent treatment. In fact, clinical experience and anecdotal reports do not appear to support the presence of positional nystagmus in >80% of the normal population.

This is not to state that positional nystagmus cannot be induced in otherwise healthy individuals. Positional nystagmus was observed in 88% of normal young adults and in

56% of elderly patients (> 64 years of age) shortly after caloric stimulation (Wu & Young, 2000). During caloric stimulation, most examiners irrigate the external ear canal with 250 ml of water for a period of 30 seconds. First, water that is 30° C is introduced to each ear, and after a short interval, water that is 44° C is used to stimulate each ear. The test is specifically designed to test the function of the horizontal semicircular canals. It is likely that positional testing in current clinical protocols precedes caloric stimulation to avoid inducing such a response.

With the exception of caloric-induced positional nystagmus, clinical observation and anecdotal evidence seem to suggest that nystagmus rarely occurs during positional testing in healthy individuals. The higher prevalence rate reported by Barber and Wright (1973) may be a result of their specialized instrumentation. The purpose of this study is to examine further this issue and reassess the incidence of nystagmus in healthy participants during positioning testing, using current technology, which does not include a motorized table.

Method

VNG is a common, clinical tool used for assessment of the vestibular system. This study will concentrate specifically on data gathered during positional testing. Positional VNG testing involves manipulation of the participant's head and body in an effort to create specific and controlled static head positions with respect to the earth's gravity. The tracings were interpreted by the author, a fourth year Doctor of Audiology student, as well as the Audiology Section Chief of Bay Pines Veterans Administration, Bay Pines, Florida who has over 23 years experience performing balance function testing using ENG.

Participants

This study examined 25 healthy participants, including three males and twenty-two females, ranging in age from 23 to 60 (Table 1) with an average age of 40.56 years. All potential participants were asked to answer a short questionnaire (Appendix A). The purpose of the questionnaire was to exclude from testing anyone who had existing vestibular system deficits, disorders of the neck or spine, recent ingestion of nystagmus-altering medications, or consumption of alcohol within the past 72 hours. All participants reported normal hearing and no history of otologic disease. Such controls are necessary

as each are known, and documented in previous studies, to impact the presence of nystagmus during positional tests (Brandt, 1991). An answer in the affirmative to any of the questions disqualified a participant from the study. Of the twenty-five participants involved, seventeen were employees of The Barranco Clinic at which this study was performed.

Table 1. Age and sex of participants in this study.

Age, years	Male	Female	Total
23-29	0	3	3
30-39	2	8	10
40-49	0	7	7
50-60	1	4	5
Total	3	22	25

Equipment

Eye movements were recorded using commercially available (Micromedical Technologies; VisualEyes/2™) computerized VNG equipment. All equipment was properly calibrated and maintained. The room temperature was set at 72° F. Lighting during testing was limited to light emitted from the computer monitor and indirect sunlight that may have filtered through the room darkening blinds covering the windows. The participant wore goggles, which were modified to accommodate the placement of the video camera over the eye as well as control the amount of light reaching their eyes. Adjusting the headband of the goggles ensured appropriate fit. Specialized image recognition software, programmed to detect the darkest region of an image, is used during VNG testing. The region of interest during this testing is the pupil. The computer application then measures and records the eye movement using this pupil tracking technology.

Procedure

Eye movements during this study were observed through a commercially available VNG system. Positional testing was performed by placing participants into nine different positions while eye movements were observed. Seven of the positions used in the current study were considered by Barber and Wright (1973). Barber and Wright used

head hanging center whereas the current study examined head hanging right and head hanging left. In the current study, participants were assisted manually into each of the nine positions. The rate at which the participant moved from one position to the next was not precisely controlled. The movements more closely approximated the repositioning rates found in clinical testing. The positions are described as sitting, 30° inclined, head-hanging right (HHR), head-hanging left (HHL), body left (BL) and body right (BR), supine head right (HR), supine head center (HC), and supine head left (HL). See Appendix A for graphic representations of the positions. The same test order was used for each participant. Each position was maintained for a period of 30 seconds. Data files containing excessive eye blinks or other noise, rendering those data unusable, were repeated.

Each participant was tested in the audiology department of The Barranco Clinic, Winter Haven, Florida office. A special area was set up specifically for the purposes of this research. The area used was private, comfortable and well lit. Facilities are regularly cleaned and all medical test equipment was electrically sound and disinfected in accordance with Occupational Safety and Health Association standards for medical facilities, employees and support personal (OSHA Standards 29 – CFR). All testing was performed during daytime hours while a licensed otolaryngologist was on duty at the facility. The participants were each informed prior to testing that data collection would be immediately suspended should any medical concerns develop during the protocol and they would be referred to the physician for any necessary assessments. In addition, each participant was told they could stop the testing at any time and would not be required to give a reason. They were also asked to report any discomfort they experienced during testing. The participants were each told what they could expect during the testing procedure including all movements and the need for the tester to physically support the patient's head and body during testing. Each participant was asked to complete the questionnaire (Appendix B), and then read and indicate his or her understanding and acceptance as a participant by signing an informed consent document (Appendix C).

At this time, the participant was asked to sit in an examination chair, and the participant was shown the video goggles that were to be used to observe their eye movements. Participants were shown that the goggles contain a special camera capable of

video recording their eye movement in the absence of light. The participants were informed that after the goggles were placed, they would not be able to monitor the visual environment without assistance from the examiner. The goggles were then placed on the head and over the eyes of the participant, providing a completely dark (blackened) visual environment. The participants were informed that within the goggles there is a small light emitting diode (LED) over the right eye and that they would occasionally be asked to fixate on this target during the tests. After the goggles were placed so that the right eye of the participant could be visualized on the computer monitor, the left eye was uncovered, an acceptable fit was obtained, and calibration proceeded. Routine calibration was carried out by asking the participant to follow a small LED that appeared on a light bar before them. They were instructed to follow the movement of this LED by moving their eyes while the head and body remained stationary. The participant was asked to keep his or her eyes open during testing so that the eye movements could be observed and tracings could be recorded. Total test time was approximately 15-20 minutes for each participant. The participant was then assisted into an upright position. The goggles were removed and the participant was free to go, after the examiner ensured that the testing had no residual effects on the participant's balance.

Results

The current study relied on computerized technology to assist in detection of the presence of nystagmus. Eye movement had to be of 6° per second or greater and had to contain both a fast and slow component to be reported as nystagmus. The recognition algorithm of the VNG system occasionally fails if there are competing areas that are equally or nearly as dark as the pupil of the eye. When such failures were detected, portions of the testing rendered unreadable were repeated (Appendix D, Table D1). Common causes of such failure are excessively dark eyeliner or mascara, dark eyelashes or improper sensitivity settings, which interfere with the software to distinguish the center of the eye from other dark regions. Eye make-up was the most common reason for the need to repeat a tracing during this study.

Nystagmus was found to be present, using the criteria for identification stated above, in 12 out of 25 participants (48%). Thus, fifty-two percent of the participants had

no nystagmus present during any position. Figure 2 illustrates these findings in comparison to the Barber and Wright study (1973).

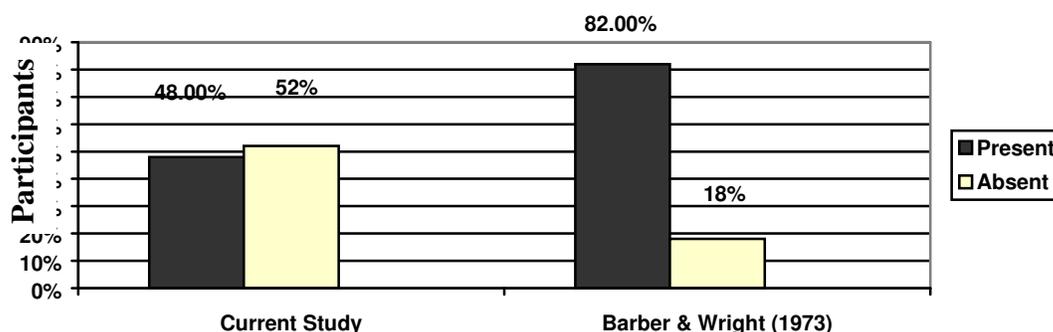


Figure 2. Percentage of participants found to have nystagmus present versus absent in current study compared to that reported in the Barber and Wright study (1973).

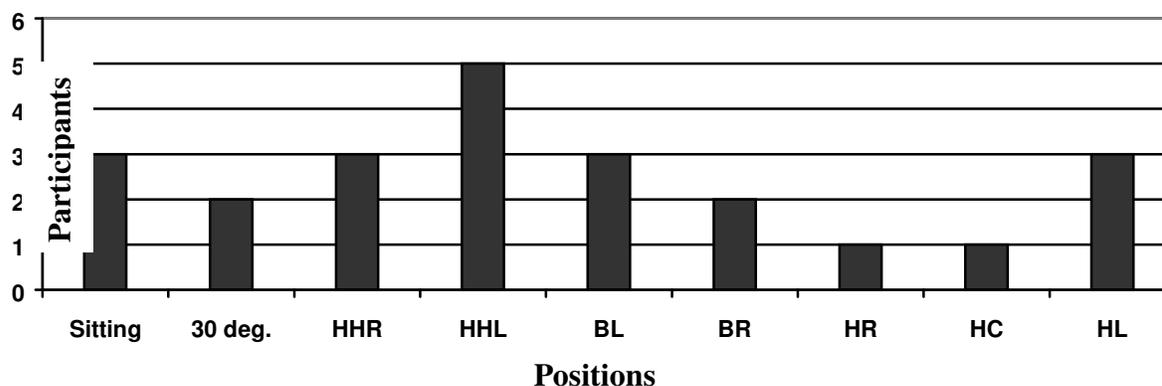


Figure 3. Number of incidences of nystagmus found per position.

The highest incidence of nystagmus in any one position was found for the head hanging left position. Two percent of the total nystagmus events detected were found in this position. The two positions in which the least nystagmus was found were head right and head center. Each of these positions accounted for 0.4% of the nystagmus present. Two participants had nystagmus considered clinically significant, using the criteria of nystagmus present in three or more positions.

In total, there were 23 incidences of nystagmus recorded out of 225 total positions (10.2%) This is compared to 45% found by Barber and Wright (1973) (Figure 4).

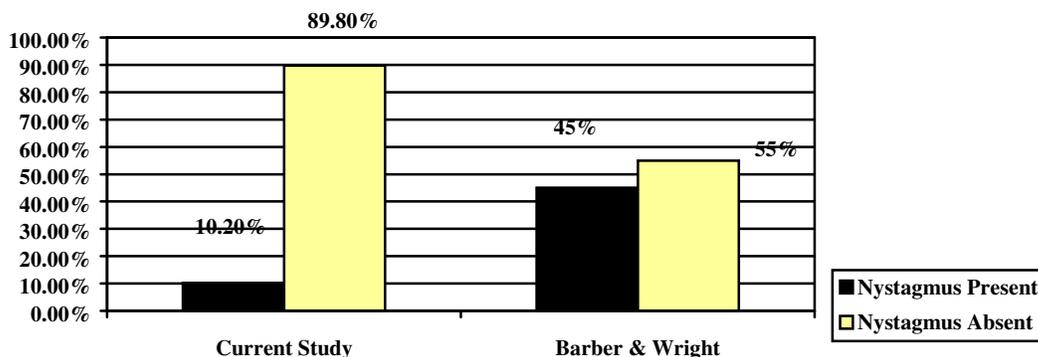


Figure 4. Total incidences of nystagmus found in each study.

No participants displayed nystagmus in all nine positions. No participants were found to display persistent nystagmus nor was nystagmus found to reverse direction during testing. In addition, no spontaneous nystagmus was found. Individual results are found in Appendix D (Table D2). The highest incidence of nystagmus in any one participant was participant #23 who displayed nystagmus in six of the nine positions tested.

Discussion

The purpose of this study was to reassess the incidence of nystagmus in healthy participants during positioning testing. Unlike the Barber and Wright (1973) study, which found the incidence of positional nystagmus to be 82%, the group of participants in the current study produced a lower, 48% incidence of nystagmus. Furthermore, 52% of the participants in the current study were identified as having no nystagmus at all as compared to 18% reported in the Barber and Wright (1973) study.

Although we feel this investigation was warranted due to an apparent discrepancy between the reported incidences of positional nystagmus in the normal population and the incidence observed clinically, this investigation should be considered preliminary. There are methodological factors that may have contributed to the observed differences between the current study and that of Barber and Wright (1973). First, the results of Barber and Wright (1973) were based on information gathered from 114 participants in 888

positions. This is obviously a larger sample size than that of the current study, which used 25 participants and interpreted results from a total of 225 positions.

Furthermore, the participants in the Barber and Wright (1973) study were randomly selected using an opinion sampling organization. No such randomization was used in the current study. The participants in this study were from a limited population. Most were employees of the clinic in which the testing was performed and some had witnessed or assisted in positional testing during their employment. The influence of comfort with the surroundings and familiarity of the procedures on the results was not determined.

Since Barber and Wright (1973) used a larger sample size, they were able to include a wider age range than utilized in the current study. Participants in their study spanned the 11 to 75 year old range. Seventeen participants in the current investigation were in their third or fourth decade of life leaving little room for age effect comparisons to be determined. In fact, a correlation analysis between maximum nystagmus and age failed to reach statistical significance ($p = 0.97$).

Despite the somewhat skewed subject ages, it is nevertheless interesting to note that the participant who displayed the highest incidence of nystagmus was 57 years of age, in the older range of the subjects. In the current study, there were three participants who were 57 years of age and one who was 60 years old. The other two 57 year olds had nystagmus present in only one position each. However, the oldest participant, who was 60 years of age, displayed no nystagmus during testing. Overall, these results are consistent with a higher incidence of positional nystagmus in older subjects, which is in agreement with reports in the literature (Isaacson & Rubin, 1999; Hajioff et. al., 2002). Isaacson and Rubin (1999) reported that dizziness is the most common presenting symptom in older patients who seek primary care. Another report has even gone so far as to say ENG testing is not able to distinguish individuals with dizziness from those without dizziness when testing an elderly population (Hajioff et. al., 2002). These authors suggest it is difficult to justify the use of ENG for diagnosis in patients over the age of 65 for this reason (Hajioff et. al., 2002). This age range is close to that of the older subjects in the current study.

A notable difference between the other older participants and the 57 year old that showed the highest incidence of nystagmus is the fact that this 57-year-old participant was in comparatively poorer health. There were, however, no health conditions which precluded her participation in the study such as otological disease. There were no medications being taken that are known to induce nystagmus. The other three older participants reported good general overall health. General health and aging effects go well beyond the scope of this particular study however may offer a possible explanation for the high incidence of nystagmus found in this participant.

A very important difference between the procedures of Barber & Wright (1973) and the current study is the use of caloric testing. At no time were any of the participants in the current study tested with caloric stimulation. Barber and Wright (1973) tested half of their participants after they had undergone caloric testing. They state that this was done in an effort to examine the effects of caloric stimulation prior to positional testing. Barber and Wright (1973) report a significant increase in nystagmus when posture tests followed caloric tests. This finding is in agreement with the literature (Wu and Young, 2000) and may also help to explain the higher incidence of positional nystagmus in their study.

For their 888 recorded positions, Barber and Wright (1973) categorized nystagmus into one of four categories. Category 1 was no nystagmus. Category 2 was called doubtful, possible nystagmus. Category 3 was doubtful, probable nystagmus, and category 4 was unequivocal nystagmus. The current study only reported nystagmus as present or absent. If categories with a designator of doubtful had been used in the current study, this may have lead to a higher incidence of nystagmus. It is common clinical practice to interpret nystagmus as present or absent as was done for the current investigation. Barber and Wright (1973) report 10% of their subjects had nystagmus categorized as doubtful, possible nystagmus and 30% had nystagmus categorized as doubtful, probable nystagmus. Again, these would be considered no nystagmus in the current study. It is interesting to note that both studies found a closer proportion of nystagmus when Barber and Wright's (1973) unequivocal nystagmus percentage is compared to the incidence reported here (48%). In Barber and Wright (1973), 60% of the total incidence of nystagmus (82%) was considered unequivocal. That is, 49.2% of their

participants were identified as having unequivocal nystagmus, a finding almost identical to that of the current study. Likewise, if the 40% incidence of doubtful nystagmus found by Barber and Wright (1973) is added to the incidence of the current study (which did not include a doubtful nystagmus category), there would be no discrepancy between the two studies.

Related to interpretation of nystagmus, no participants in the current study were found to display persistent nystagmus. This is in contrast to Barber and Wright (1973), which reported that 5% of the participants had a combination of intermittent and persistent positional nystagmus in all eight of their positions tested. In addition, no nystagmus was recorded which reversed direction during testing in the current study or in Barber and Wright (1973). Likewise, spontaneous nystagmus was not observed for either investigation.

Finally, Barber and Wright (1973) used a motor-driven table to position their participants. This special table allowed the head, neck and body of the participant to be moved together and reduced neck movement. This was not the case in the current study. In the current study, participants were instructed to turn their head as far as they comfortably could to the left and that on the count of three they would be assisted to lay back as quickly as possible, allowing their head to hang over the edge of the table while keeping their head turned to the left. This process was then repeated with the participant's head turned to the right. The variation in speed of movement as well as degree of final position may have influenced the differences in incidence between the two studies.

The results of this study suggest that there is a proportion of normal, healthy adults without otological abnormalities who present with positional nystagmus. The actual incidence is likely to vary depending on criterion for determining if nystagmus is present or absent. The potential clinical impact of this finding is that if positional nystagmus is recorded in a symptomatic patient, it continues to be difficult to determine if the nystagmus represents normal variation or if it is an indicator of underlying pathology. Since this is only a preliminary investigation using a small number of subjects, it would not be reasonable to revise normative data based only on the current findings. However, clinicians should be aware that their criterion for determining

presence or absence of nystagmus may have an effect on interpretation, at least for positional testing.

Summary

The purpose of this study was to reassess the incidence of nystagmus in healthy participants during positioning testing, using current technology. A comparatively low, 48%, incidence of nystagmus was found. This is nearly half the commonly reported incidence of 82% (Barber & Wright, 1973). This discrepancy reported in incidence is almost entirely eliminated when methodological differences between the studies are considered, specifically criterion for presence of nystagmus. Based on the results of this preliminary study, and the results from the unequivocal nystagmus group of Barber and Wright (1973), clinicians may expect to record positional nystagmus in approximately half of patients with no symptoms if a presence/absence criterion is utilized. Based on the overall findings of Barber and Wright (1973), if a more liberal criterion including “doubtful” categories is used, clinicians should record positional nystagmus in approximately 82% of patients. Of course, each case must be interpreted with individual case history, presenting symptoms, and complete diagnostic information.

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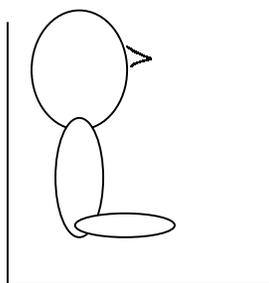
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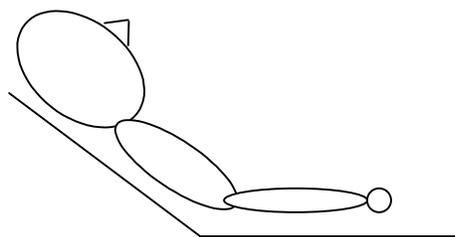
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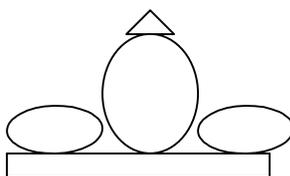
Appendix A



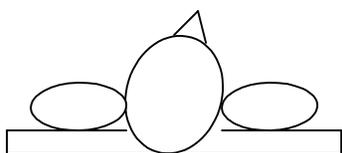
Sitting



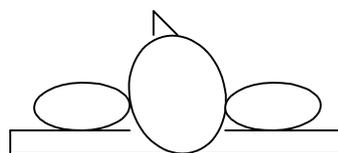
30°



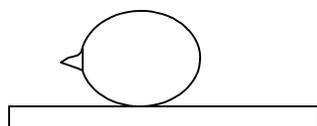
Supine



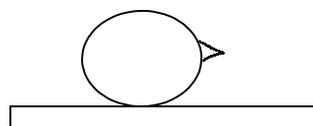
Head Hanging Right



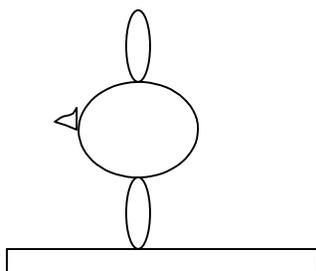
Head Hanging Left



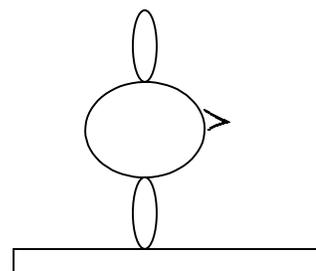
Head Left



Head Right



Body Left



Body Right

Appendix B

Positional Nystagmus Study

Please answer the following questions Yes or No

1. Have you ever had any of the following diagnosis or conditions:
Dizziness, vertigo, basilar insufficiency, central vestibular or brainstem disorders, peripheral labyrinth, perilymphatic fistula, meniere's disease, vestibular atelectasis, vestibular head motion intolerance, ocular motor disorders, bilateral vestibulopathy, migraines, vestibulocerebellar ataxia, post-traumatic otolith vertigo, or vestibulo cerebellar intoxication

	Yes	No
--	-----	----
2. Have you ever been diagnosed with neural disease?

	Yes	No
--	-----	----
3. Have you ever been diagnosed with vestibular disease?

	Yes	No
--	-----	----
4. Have you ever been diagnosed with otologic disease?

	Yes	No
--	-----	----
5. Have you ever had ear surgery?

	Yes	No
--	-----	----
6. Have you ever had any type of head injury?

	Yes	No
--	-----	----
7. Do you have now or have you ever had neck or back pain?

	Yes	No
--	-----	----
8. Please list current medications you take
9. Have you consumed any alcohol in the past 72 hours?

	Yes	No
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Appendix C

Social Sciences/Behavioral Adult Informed Consent

University of South Florida

Information for People Who Take Part in Research Studies

The following information is being presented to help you decide whether or not you want to be a part of a minimal risk research study. Please read carefully. If you do not understand anything, ask the Person in Charge of the Study.

Title of Study:	The Incidence of Positional Nystagmus in Healthy Participants; Revisited
Principal Investigator:	Terri L. Schneider
Study Location(s):	The Barranco Clinic, Winter Haven, Florida

You are being asked to participate in a study that has been designed to measure eye movements in relationship to head position. Past studies have been conducted in which eye movements were measured about 80% of the time in normal subjects for these head positions. Clinical data suggest that this incidence is actually much lower. Your eyes will be monitored for such movements. Your head and body will be placed into nine positions for less than a minute.

General Information about the Research Study

- The purpose of this research study is to investigate the incidence of eye movement, associated with head positions under highly controlled conditions, present in healthy participants. Certain disorders can be identified based on the existence of abnormal eye movement during different head positions. Past studies have reported 82% of healthy individuals will exhibit abnormal eye movement for the head positions used in clinical testing. During clinical tests, few normal subjects demonstrate these eye movements. The purpose of this study is to re-investigate this matter. The number of people who may take part in this study is 25. An examiner will be with each research participant throughout the entire procedure.

Plan of Study

- At the beginning of the session, you will be asked to answer several questions regarding your overall health and, in particular, your past history of balance and dizziness disorders. Your answers to these questions will determine your candidacy for the research study. During the study, you will be seated in an examination chair. Goggles, which record eye movement using small video cameras, will be placed over your eyes. These goggles will obstruct your vision. You will be asked to relax and keep your eyes open as the investigator moves your head and body into nine different positions. You may be asked not to blink and to stare occasionally at a small dot or light. You will be asked to count aloud (numbers) to enhance mental alertness during testing. Total test time will be approximately 15 minutes.

Payment for Participation

- You are being asked to participate on strictly a volunteer basis and no compensation is being offered for this participation.

Benefits of Being a Part of this Research Study

- The practical benefits of this research study are not likely to apply directly to you. The procedures used in this study are not intended to be harmful, therapeutic or rehabilitative in any way. If you are an employee or family member of an employee of The Barranco Clinic, your status will not be affected by your participation, and you will not receive special benefits.

Risks of Being a Part of this Research Study

- There are no known significant risks related to participation in this research study. The head and body movements are naturally experienced by many individuals throughout the course of any given day. If you should experience any discomfort during testing, testing will be terminated immediately and you will be encouraged to seek relief for any problems you may be experiencing. Participants may experience an unlikely (<1%) episode of vertigo and/or bodily injury. All test equipment is disinfected before each use by any research participant. Not being able to see may be disconcerting. There will be at least one licensed physician in the clinic during all testing should you feel you need to seek their advice. The information provided by this study is significant and potentially valuable to the medical community. These data will assist the diagnosis and medical management of the balance-impaired client.

Confidentiality of Your Records

- All research records will be kept confidential to the extent of the law to ensure your privacy is maintained, only authorized research personnel, employees of the Department of Communication Science and Disorders, and the USF Institutional Review Board may inspect the records from this research project.

The results of this study may be published. However, the data obtained from you will be coded and combined with data from other people in the publication. The published results will not include your name or any other information that could in any way identify you personally.

Individual data will be stored and identified using a number code.

Volunteering to Be Part of this Research Study

- Your decision to participate in this research study is voluntary. You are free to participate in this research study or to withdraw at any time. If you choose not to participate, or if you withdraw, there will be no penalty. You may ask that your data not be used in the study. Likewise, the investigator may terminate participation of a subject at any time and without advance notice.

Questions and Contacts

- If you have any questions about this research study, contact Terri L. Schneider at (863) 299-1251.
- If you have questions about your rights as a person who is taking part in a research study, you may contact a member of the Division of Research Compliance of the University of South Florida at (813) 974-5638.

Your Consent—By signing this form I agree that:

- I have fully read or have had read and explained to me this informed consent form describing a research project.
- I have had the opportunity to question one of the persons in charge of this research and have received satisfactory answers.
- I understand that I am being asked to participate in research. I understand the risks and benefits, and I freely give my consent to participate in the research project outlined in this form, under the conditions indicated in it.
- I have been given a signed copy of this informed consent form, which is mine to keep.

 Signature of Participant

 Printed Name of
Participant

 Date
Investigator Statement

I have carefully explained to the subject the nature of the above protocol. I hereby certify that to the best of my knowledge the subject signing this consent form understands the nature, demands, risks and benefits involved in participating in this study.

 Signature of Investigator
Or Authorized research
investigators designated by the
Principal Investigator

 Printed Name of
Investigator

 Date
Institutional Approval of Study and Informed Consent

This research project/study and informed consent form were reviewed and approved by the University of South Florida Institutional Review Board for the protection of human subjects. This approval is valid until the date provided below. The board may be contacted at (813) 974-5638.

Approval Consent Form Expiration Date:

Revision Date: _____

Appendix D

Table D1. Positions that were repeated.

	Sitting	30°	HHR	HHL	BL	BR	HR	HC	HL
#6	R	R	R	R	R	R	R	R	R
#8			R	R	R				
#9				R					
#10	R	R	R		R		R	R	R
#11						R			
#12				R	R				
#13							R	R	R
#14					R				
#15		R							

Table D2. Positions in which each participant had nystagmus. P = Nystagmus present.

Participant	Sitting	30°	HHR	HHL	BL	BR	HR	HC	HL
1									
2	P			P					
3	P								
4									
5	P			P					
6									
7			P						
8									
9									
10									
11									
12			P						
13									
14									
15									
16				P	P				P
17					P				
18		P							
19									P
20				P					
21									
22		P							
23			P		P	P	P	P	P
24				P		P			
25									
Total	3	2	3	5	3	2	1	1	3