This is a Sample version of the

Motion Sensitivity Test (MST) or
Motion Sensitivity Quotient (MSQ)

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- Clinical Study & results
- Review
- Administration Instructions
- Complete MST assessment criteria

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Validity and reliability of the Motion Sensitivity Test

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Includes indepth MST discription and Complete MST/MSQ Assessment. Located in Appendix.

Abstract—The Motion Sensitivity Test (MST) is a clinical protocol designed to measure motion-provoked dizziness during a series of 16 quick changes to head or body positions. The MST has been used as a guide for developing an exercise program for patients with motion-provoked dizziness and as a treatment outcome measure to monitor the effectiveness of vestibular rehabilitation therapy. This study determined validity, test-retest reliability, and interrater reliability of the MST. Fifteen individuals with motion-provoked dizziness and ten control individuals were tested during sessions occurring 90 min and/or 24 hr after baseline testing. The MST was found to be reliable across raters (intraclass correlation coefficient [ICC] = 0.99) and test sessions (ICC = 0.98 and 0.96). Test validity was good. The results indicated that the MST can be used reliably in clinical practice to develop exercise programs for patients with motion-provoked dizziness and to provide evidence of intervention efficacy.

Key words: dizziness, falls, habituation, vestibular function tests.

INTRODUCTION

According to studies from the National Institutes of Health (NIH), 90 million Americans (42% of the population) will complain to their doctors of dizziness at least once in their lifetime [1]. The prevalence is increased in the elderly with ~25 to 30 percent of community-dwelling elders experiencing frequent dizziness [2,3]. Chronic dizziness can lead to persistent unsteadiness and increased risk of falling and thus contribute to physical, psychological, and social disability [4].

More than 50 percent of the accidental deaths in the elderly are due to balance-related falls of which dizziness is frequently an associated symptom [1]. Falls account for 250,000 hip fractures each year in persons over age 65 [5]. Twenty-five percent of these individuals die within a year and fifty percent are unable to return to an independent lifestyle [6,7]. The total direct cost of fall injuries is currently $20 billion a year and is expected to reach $32.4 billion by the year 2020 [8].

A common complaint of patients with balance disorders is motion-provoked dizziness. Motion-provoked dizziness refers to a disturbing sense of vertigo or dizziness associated with head movement. This dizziness is often

Abbreviations: ICC = intraclass correlation coefficient, MST = Motion Sensitivity Test, VRT = vestibular rehabilitation therapy.

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caused by some permanent and stable vestibular dysfunction that can be elicited during head movement [9]. Vestibular dysfunction may cause a decrease in vestibulocular reflex gain that results in dizziness and/or visual blurring during movements of the head. According to Norrè and Beckers, motion-provoked dizziness resolves when sufficient central compensation occurs following a vestibular imbalance [9]. Although most patients with vestibular disturbances recover spontaneously owing to central compensation, some patients continue to experience chronic dizziness, particularly during head movements.

Vestibular rehabilitation therapy (VRT) is a relatively new treatment for many patients suffering from dizziness and/or balance disorders. VRT stimulates and enhances normal compensatory mechanisms through repeated performance of eye, head, or body movements that provoke dizziness. VRT includes habituation exercises, adaptation exercises, and gait and balance exercises. Habituation exercises are a key component of VRT for patients who experience motion-provoked dizziness. Habituation is defined as a long-term reduction in the pathological response to particularly noxious stimuli [10]. Habituation exercises to treat vertigo were first described by Norrè and DeWeerd in the early 1980s and consist of individually selected symptom-provoking head motions designed to encourage vestibular compensation [11,12]. For example, a habituation exercise might be repeated rolling over in bed for a patient whose symptoms were provoked by this activity. The timing and magnitude of the habituation response to customized daily exercises vary among patients, occurring in as little time as 2 weeks in some patients while taking up to 6 months in others. Most patients will begin to experience dramatic relief of symptoms within 4 to 6 weeks of performing daily habituation exercises [13].

The Motion Sensitivity Test (MST) is a clinical technique to measure motion-provoked dizziness in patients with vestibular disturbances using a series of 16 quick changes to head or body position. The severity and duration of the dizziness are recorded for each position and a cumulative score, the MST quotient, is calculated. The MST was adapted by Smith-Wheelock et al. from Norrè and Beckers’ vestibular habituation training test battery that was developed to account for the variability in specific positions that provoke symptoms in dizzy patients [14,15].

The MST has been used as a guide for developing an exercise program to meet the individualized needs of patients with motion-provoked dizziness and as a treatment outcome measure to monitor the effectiveness of VRT [10,16,17]. Although the test has been used for nearly a decade to guide treatment and to measure small changes in symptoms over time, the reliability of the MST has not been investigated. If the MST is to be used clinically to evaluate change in the severity and duration of a patient’s motion-provoked dizziness, then the reliability of the instrument needs to be determined. Test-retest reliability would indicate that the MST could be used to measure change in symptoms over time. Interrater reliability would indicate that the MST score is consistent when measured by different clinicians. Once reliability is determined, the MST can be used to measure treatment outcome in patients undergoing VRT for motion-provoked dizziness. Finally, the validity of the test needs to be established to be certain that the test appropriately identifies individuals with motion-provoked dizziness. This study determined the test-retest reliability, interrater reliability, and validity of the MST.

METHODS

Subjects

Two groups of community-dwelling individuals participated in the study, and data were collected at two regional senior citizen centers. The first group included 15 subjects (8 males and 7 females), ranging in age from 43 to 86 (mean = 65 years), with complaints of motion-provoked dizziness during routine movements associated with daily living. The extent of symptoms varied from dizziness occurring in a single head position to dizziness occurring with multiple head movements. The second group included 10 control subjects (6 males and 4 females), ranging in age from 37 to 79 (mean = 66 years), with no complaints of motion-provoked dizziness. Subjects’ approval was obtained and the procedures followed the standards of the institutional review board.

Motion Sensitivity Test

The MST was administered according to the clinical protocol described by Smith-Wheelock et al. [14]. Each subject performed 16 different head and/or body movements in the following order:

1. Sitting to supine.
2. Supine to left side.
3. Supine to right side.
4. Supine to sitting.
5. Left Dix-Hallpike (sitting to supine, head hanging to the left).
6. Head up from left Dix-Hallpike.
7. Right Dix-Hallpike (sitting to supine, head hanging to the right).
8. Head up from right Dix-Hallpike.
9. Sitting with head tipped to left knee.
10. Head up from left knee.
11. Sitting with head tipped to right knee.
12. Head turns while sitting.
13. Sitting head tilts.
14. 180° turn to right while standing.
15. 180° turn to left while standing. (A sample blank form of the MST used in this study can be found in the Appendix that appears in the on-line version only).

Each subject was instructed to indicate the onset and offset of any dizziness that occurred in each position. The duration of dizziness, which was recorded with a stopwatch, was assigned the following values: 1 point for 5 s to 10 s of dizziness, 2 points for 11 s to 30 s of dizziness, and 3 points for >30 s of dizziness. Once the duration was recorded for a position, the subject was asked to rate verbally the intensity (severity) of the dizziness just experienced on a scale of 0 to 5 (0 = no symptoms; 5 = severe dizziness). By adding the duration score to the intensity score, investigators calculated a raw score for each position. The maximum raw score for each of the 16 positions is 8 points (3 points for dizziness lasting >30 s and a score of 5 points for severe dizziness); the total possible MST raw score is 128 (8 points × 16 positions). The MST quotient was calculated with the use of the formula [14]

\[
\text{MST quotient} = \left(\frac{\sum\text{duration} \times \text{intensity}}{\text{No. of dizziness-provoking positions}}\right) \times 2,048 \times 100.
\]

The MST quotient equals the number of positions that provoked symptoms times the intensity and duration total for all positions divided by 2,048. In the formula, 2,048 = 16 (total number of positions) × 128 (total possible MST raw score). One can then calculate a percentage score by multiplying by 100. Thus, an MST quotient of 0 indicates no symptoms, whereas an MST quotient of 100 indicates severe unrelenting symptoms in all positions. In the formula, the number of positions in which dizziness occurs is weighted more than the intensity and duration of the dizziness. For example, a subject may have maximum intensity and duration scores (i.e., 5 and 3, respectively) in 3 of the 16 positions for a 2.6 MST quotient. In contrast, another subject may have mild dizziness (intensity = 1) and short duration (duration = 1) in all positions for a 25 MST quotient. If a subject reported dizziness prior to the MST (at rest), then the intensity score at rest was subtracted from the intensity score for each position, so the MST quotient only reflected the dizziness that occurred from position changes.

Procedure
To determine the test-retest reliability of the MST, examiners tested the subjects with motion-provoked dizziness at two intervals ~24 hr apart. Eight of the fifteen subjects with motion-provoked dizziness were able to remain for a third test session at 90 min after baseline. To determine intrarater reliability, two examiners simultaneously measured the duration and recorded the intensity of symptoms during 20 sessions performed on the motion-provoked dizziness group. The examiners were blinded to the observations of one another, but both were present in the same room for the test sessions. These sessions were randomly selected among the 38 test-retest sessions (fifteen baseline sessions, eight 90 min after baseline sessions, and fifteen 24 hr after baseline sessions). To determine if asymptomatic subjects experience dizziness on the MST, examiners also performed the test on a group of 10 control subjects during one test session.

Analysis
Test-retest and intrarater reliability of the MST was evaluated with the use of intraclass correlation coefficients (ICCs). This statistical index was chosen because of its broad clinical applicability and because it reflects both correlation across test sessions and agreement among examiners [19]. ICCs were calculated with the use of one-way analysis of variance (ANOVA) to produce the mean square data to factor out the variance. The ICC for intrarater reliability was determined with the use of the formula

\[
[\text{ICC}(1,1) = \frac{\text{BMS} \times \text{WMS} + \text{BMS} – \text{EMS}}{\text{EMS} + \text{BMS} – \text{EMS}} + \text{EMS}; \text{WMS}\text{.}]
\]

in which BMS = between subjects mean square, WMS = within groups mean square, and k = number of sessions. The ICC for test-retest reliability is determined by

\[
[\text{ICC}(3,1) = \frac{\text{BMS} \times \text{EMS} + \text{BMS} – \text{EMS}}{\text{EMS} + \text{BMS} – \text{EMS}} + \text{EMS}; \text{WMS}\text{.}]
\]

This is the end of the sample MST/MSQ Clinical study. Please return to page 1 to purchase full complete version.
# Motion Sensitivity Quotient/ Test

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<th>Title of Assessment</th>
<th>Motion Sensitivity Quotient/ Test</th>
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<tr>
<td>Acronym</td>
<td>MSQ / MST</td>
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<tr>
<td>Instrument Reviewer(s)</td>
<td>Initially reviewed by Advaita Subbedar in 10/2012; Updated by Jennifer Fay, PT, DPT, NCS and Tracy Rice, PT, MPH, NCS and the Vestibular EDGE task force of the Neurology Section of the APTA in 2013.</td>
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<td>Purpose</td>
<td>Clinical test designed to measure motion-provoked dizziness during a series of 16 quick changes to head or body positions. May also be used as a guide for developing an exercise program for patients with motion-provoked dizziness.</td>
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## Description
- Each subject performs 16 different head and/or body movements and instructed to indicate the onset and offset of any dizziness that occurred in each position.
- The duration of dizziness, which was recorded with a stopwatch, is assigned the following values: 1 point for 5s to 10s of dizziness, 2 points for 11s to 30s of dizziness, and 3 points for > 30s of dizziness.
- Subject is also asked to rate the intensity of the dizziness on a scale of 0 to 5 (0 = no symptoms, 5 = severe dizziness).
- A raw score for each position is calculated by adding duration score to the intensity score.
- MST quotient equals number of positions that provoked symptoms times the intensity and duration total for all positions divided by 2,048.
- MST quotient of 0 indicates no symptoms; MST quotient of 100 indicates severe unrelenting symptoms in all positions.
- Improvement is indicated by:
  - Decreased number of provoking positions
  - Increased number of reps before symptom occurrence
  - Decreased intensity of symptoms
  - Shorter duration of symptoms

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<td>Age Range</td>
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<td>Diagnosis</td>
<td>Geriatrics; Traumatic Brain Injury; Vestibular Disorders</td>
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| Populations Tested | Community dwelling individuals with complaints of motion provoked dizziness during routine movements associated with daily living
  - Geriatrics
  - Traumatic Brain Injury
  - Vestibular Disorders |
| Standard Error of Measurement (SEM) | Not Established |
| Minimal Detectable Change (MDC) | Not Established |
| Minimally Clinically Important Difference (MCID) | Not Established |
| Cut-Off Scores     | Raw score: 0-128
  - Mild = 0-10
  - Moderate = 11-30
  - Severe = 31-100 |
be done for this scale.
Similarly, the research conducted on this scale has small sample sizes. Larger sample sizes and more
data have to be collected about this scale.

Do you see an error or have a suggestion for this instrument summary? Please email us!

**Bibliography**


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