The reliability of a physical therapist to remotely identify gross horizontal plane asymmetry in health subjects: a pilot study

Tiffany Lenk
Medical College of Ohio

Follow this and additional works at: http://utdr.utoledo.edu/graduate-projects
The Reliability of a Physical Therapist to Identify Gross Horizontal Plane Asymmetry in Health Subjects: A Pilot Study

Submitted by

Tiffany Lenk

In partial fulfillment of the requirements for the degree of Master of Science in Biomedical Sciences

Academic Major Advisor
Matthew T. Volansky, P.T., M.B.A.

Chairperson
Clayton Holmes, Ed.D., P.T.

Dean, School of Allied Health
Christopher E. Bork, Ph.D.

Dean, Graduate School
Keith K. Schlender, Ph.D.

Date of Presentation: December 6, 2004

Date of Approval: 12-14-04

Signatures

Matthew T. Volansky, P.T., M.B.A.
Clayton Holmes, Ed.D., P.T.
Christopher E. Bork, Ph.D.
Keith K. Schlender, Ph.D.
The Reliability of a Physical Therapist to Remotely Identify Gross Horizontal Plane Asymmetry in Healthy Subjects - A Pilot Study

Tiffany Lenk, BS
Introduction

The field of telemedicine began 40 years ago, primarily as a development of the Department of Defense (DoD) and The National Aeronautics and Space Association (NASA). The DoD began using and performing research with telemedicine during the Vietnam War, and continues working on many projects to this day. NASA uses forms of telemedicine to promote an active monitoring of astronauts in space. NASA also participates in research concerning wireless telemedicine using satellites. Another early use of telemedicine was for prison inmates in states such as Texas, North Carolina, and Kentucky. The development of telemedicine has made it easier to provide medical care to these inmates without having to deal with security issues.¹

In the past few years, the field of telerehabilitation has grown from the larger field of telemedicine. The field is moving more towards everyday usage. According to Winters² there are several benefits of this type of intervention, including minimizing the barrier of distance for patients in rural communities, both for patients and caregivers. Lemaire, Boudrias, and Greene³ illustrate the benefits of improved clinical support in local communities, indirect educational benefits, and improved access to specialized services, because of telemedicine. Telerehabilitation not only saves time, it reduces the cost of care for the patient and their insurance provider. However, according to Williams et. al.⁴, telerehabilitation as a field has been criticized because there is little clinical evidence to support its usage. This is especially true for the field of physical therapy. For this reason, more research is needed in order to demonstrate the benefits that this field has to offer.

This current study of telerehabilitation practice focuses on the single horizontal plane motion of the cervical spine. Using the Cervical Range of Motion device (CROM), this
investigation will obtain measurements of cervical spine left and right rotation of subjects in order to provide a gold standard to document the presence or absence of asymmetry. Using these measurements, the researchers will be able to correlate the observation findings of the examiner, showing the accuracy of observation in relationship with the actual presence of symmetry or asymmetry.

The CROM was chosen because research states it is the most reliable instrument for measuring cervical motions, excluding radiography. According to Tucci et. al. there are several drawbacks to using radiography, including radiation exposure, expense, time consumption, and equipment availability. Because of this, when radiography is not available, the CROM is considered to be the next reliable instrument. According to studies by Youdas et. al. the CROM produces greater reliability results than both visual estimation and the universal goniometer. The aforementioned researchers found Intraclass Correlation Coefficients (ICC) values of greater than .80 in both studies for intra-rater and inter-rater reliability. Using a previously determined scheme, these values indicate good reliability. A study by Capuano-Pucci et. al. also showed the intra-tester and inter-tester reliability of the CROM to produce good ICC values for both (.62 to .90, and .80 to .87 respectively).

Before taking measurements with the CROM device, the researcher should be familiar with the normal ranges of motion for the cervical spine. According to Capuano-Pucci et. al., the mean range of motion right rotation is 0-70.8 degrees, and for left rotation is 0-68.6 degrees. As cited by Norkin and White, the American Academy of Orthopedic Surgeons guidelines state normal right rotation 0-60 degrees and left rotation as 0-60 degrees as well. In a study by Chen et. al., a meta-analysis of 38 studies using 11 measurement devices, up to 12°-20° variation in measurement existed in repeat measurements taken over a 3 week period. Given this
information, for the purposes of the current study, any differences between the right and left rotation measurements made with the CROM greater than ±4° will be classified as asymmetrical.

Also included in the data collection will be the subjects’ perception of their cervical disability level. In order to gather this information, the Neck Disability Index (NDI) will be administered to subjects at the time of testing. The NDI is a 10 question survey which asks clients to rate the level of disability that they feel they are experiencing in relationship to different activities of daily living (ADLs) because of their neck impairment. Each item on the survey has 6 choices, with each representing a score of 0 to 5, with 0 representing no disability and 5 representing severe disability. The total score of the NDI is taken out of 50. In a study by Vernon and Mior, the NDI showed a high degree of test-retest reliability, with a correlation coefficient of 0.89. It also showed high internal consistency, with all items on the 10-item scale achieving an alpha coefficient of 0.76.

In order to show the benefits of telemedicine interventions, the reliability of the observations and validity of the inferences from these observations, taken through telerehabilitation studies, must first be established. To date, there is little evidence-based research in this area. To enhance credibility of the field, clinicians must first show that a telerehabilitation encounter will produce the same results as a face-to-face visit with the health care professional. This is the aim of the current study, to prove that observations of cervical spine asymmetry made by the same therapist in a face-to-face encounter will be similar or equal to the values found by observations of cervical spine asymmetry when watched during video taped playback.

The primary outcome is to establish that physical therapists can reliably identify asymmetrical motion within the normal variability that exists within the population. There are
three hypotheses for the current study: 1) A physical therapist is able to reliably identify the presence of asymmetrical horizontal plane cervical active motion within the normal population when comparing live motion vs. video motion analysis. 2) A physical therapist is able to reliably identify the direction of asymmetrical horizontal plane cervical active motion within the normal population when comparing live motion vs. video motion analysis. 3) A physical therapist is able to reliably identify the magnitude of asymmetrical horizontal plane cervical active motion within the normal population when comparing live motion vs. video motion analysis.
Methods

Subject Inclusion/Exclusion

Subjects were included if they were greater than age 18 years of age, were English speaking, demonstrated the ability to follow two-step commands and the ability to hear. Subjects were excluded if they were non-English speaking, there was the presence of a perceived inability to sit for approximately 15 minutes, the inability to perform 2 step commands, or they were post-op acute surgical AROM restricted patients.

The study consisted of a convenience sample of 17 subjects, 9 male and 8 female, between the ages of 18 and 89. The mean age for males was 45, with a standard deviation of 27.9. The median age among males was 34.5. The maximum age among males was 89, and the minimum age was 24. The mean age of females was 45, with a standard deviation of 22. The median age among women was 34. The maximum age among females was 83, and the minimum age was 18.

The researcher for the study was a physical therapist with 13 years of orthopedic clinical experience and was a board certified orthopedic clinical specialist as designated by the APTA Board of Clinical Specialties.

Protocol

The following is a summary of the protocol used to gather the data for the present study: Subjects were asked to enter clinic, informed consent was explained and received by primary investigator, and then subjects were given subject data form and Neck Disability Index\textsuperscript{11} (NDI), and Visual Analog Scale (VAS) for pain rating. The subject’s handedness was observed by investigator as well. After completion of these documents, the subjects walked to test site, and the test was administered in sitting as per the protocol defined by Youdas et al.\textsuperscript{7}: Subject seated
in chair, feet flat on floor, arms rested freely at sides, street clothes, hair pulled back (if needed) to expose ears, jewelry or clothing removed which might obstruct neck AROM, thoracic spine maintained contact with chair’s backrest during movement, lumbosacral spine filled the gap between the seat and the backrest. Subjects were then placed in standardized head initial position, and three warm up repetitions of left and right rotation were performed to increase compliance of neck’s soft tissues. The end point of motion was operationally defined as point at which the subject’s AROM was limited by muscle tightness or pain or a substitution movement. The patient chose a randomized starting direction of either left or right rotation. Then 3 consecutive repetitions of rotation in the same direction were performed. The investigator recorded the presence of asymmetry (yes/no), the direction of the asymmetry if present (right/left) and the magnitude of the asymmetry if present (Min, Mod, Max, Severe). All subjects were videotaped at the time of live measurement, and the speed of movement was self paced “like a pendulum on a clock”. Participants were videotaped throughout the data collection process. The distance of camera was adjusted (via zoom) to allow chest and up view (nipple line). The angle of the camera was standard (36” height). The CROM was placed on subjects as per manufacturer’s suggestion (Performance Attainment Associates, St. Paul, MN), instructions were repeated for end point of AROM, start and end measurement taken via CROM by live expert investigator, 3 measurements were recorded, subjects thanked and excused. 2 weeks after initial data collection, the same expert investigator analyzed the same subjects via videotape, in the same order, and recorded the presence of asymmetry (yes/no), the direction of the asymmetry if present (right/left) and the magnitude of the asymmetry if present (Min, Mod, Max, Severe). The live motion analysis was then compared to the video motion analysis to find the level intra-rater reliability that was present.
After raw measurements were taken, the average and standard deviation for each subject’s ranges were calculated using Microsoft Excel. The AROM difference was calculated by subtracting the average of the left measurements from the average of the right measurements. The ranges for each of the subjects were then determined to be symmetrical or asymmetrical based on whether the difference between left and right was between -4 and 4 degrees (the previously defined definition of symmetry). The live investigator then recorded observations of each subject in regards to asymmetry, direction of asymmetry, and the magnitude of asymmetry. These observations were recorded both at the time of data collection and two weeks later after viewing the videotapes of subjects.
Results

Statistics were performed using SPSS version 11.5 with an alpha level of 0.05. Cohen’s Kappa was used to establish the degree of intra-rater reliability between live and video motion analysis of direction, presence, and magnitude of asymmetry. When comparing the Live Motion Analysis (LMA) vs. Video Motion Analysis (VMA) intra-rater reliability of identifying the presence of asymmetry, Kappa=0.881 with a standard error of 0.240, indicating very good reliability based on the D. Altman (Practical Statistics for Medical Research) guidelines\(^\text{12}\). The proportion of agreement observed \(P_o = 0.941\), also indicating very good reliability. When comparing the LMA vs. VMA intra-rater reliability of identifying direction of asymmetry, Kappa=0.896 with a standard error of 0.187, again indicating very good reliability. Proportion of agreement observed \(P_o = 0.941\), again indicating very good reliability. When comparing the LMA vs. VMA intra-rater reliability of identifying magnitude of asymmetry, Kappa=1 with a standard error of 0.186, indicating a perfect agreement of identification of this variable.

When reviewing the data collected, an interesting trend was observed when looking at the relationship of the NDI scores and the VAS scores. In order to see the level of correlation between these two variables, Pearson’s correlation was performed, and Pearson’s correlation=0.904, \(p=0.01\). This indicates a high positive correlation between subjects score on the NDI as compared to their score on the VAS. As the score on the NDI increased, so did the score on the VAS. However, a high NDI score did not necessarily indicate the presence of asymmetry. In 4 out of 6 cases where the NDI score was greater than 5\%, asymmetry was not observed by the definition used in this study. This may possibly be due to the Hawthorne effect\(^\text{12}\), as the subjects knew they were being studied.
Discussion

The results of this study indicate a high intra-rater reliability of an expert physical therapist to identify the presence, direction, and magnitude of asymmetry using both LMA and VMA. The results also indicate a high correlation between scores on the NDI and VAS scales indicating neck disability and pain levels. There was not, however, a correlation found between the scores on the NDI and actual presence of asymmetry.

Current research in the area of physical therapy as it relates to telemedicine practice tends to focus on complex motion analysis such as gait analysis, special test delivery, etc. This study focuses on a single fundamental motion analysis as opposed to studying multiple variables simultaneously. Based on this study, it appears that use of a systematic protocol of remote motion analysis is a reliable method of screening normal patients for gross abnormalities. This study may be used in future research to provide a reliable method of remote motion analysis of other commonly observed orthopedic impairments in other movement patterns at different joints of the body.

Future studies should use a larger sample size to show more powerful and consistent results. The abilities of several therapists to observe the presence, direction, and magnitude of asymmetries should be studied, to see the inter-rater reliability of LMA vs. VMA analysis. Researchers should also compare the inter-rater reliability of therapists with different levels of experience (i.e. novice vs. expert) in identifying cervical horizontal plane asymmetry. These types of studies will show the ability of the same results to be generalized across different subjects and different researchers using the same protocol. Studies should also look at subjects with cervical AROM abnormalities, in order to show that clinicians can see progression of treatment and changes in the AROM observed. Eventually, researchers should attempt to use
live motion vs. Internet broadcast motion analysis to show validity/reliability of use for
telerehabilitation purposes. This type of research would show the application of the findings to
real-life clinical settings and use as a screening tool for actual patients.
References


