Psychomotor Training for Performance of the Deep Neck Flexor Test

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ABSTRACT

Background and Purpose: Psychomotor training is integral to physical therapy education. Skill attainment in examination procedures, as well as interventions, requires structured psychomotor learning and practice. The deep neck flexor test (DNFT) represents a special test designed to assess the neuromuscular control of the deep neck flexor muscles. Previous research indicates inter-rater reliability of the craniocervical flexion test (CCFT) as ranging from an intraclass coefficient value (ICC) of 0.63-0.82. Although the evidence for reliability of the CCFT appears to support the use of the test, the CCFT is not as clinically applicable due to time constraints as well as the need for use of a specialized pressure biofeedback cuff. The purpose of this research was to determine the agreement in performance among DPT student raters of the DNFT. A second aim of the research was to describe how the process of obtaining agreement was incorporated into the student research process through a process of feedback and training provided by mentors. **Methods:** Four DPT students participated in a trial determining tester agreement in performance of the DNFT. A corollary to this study was to determine whether their agreement in performance of the test would allow them to participate in data collection in a larger clinical trial. The latter study would be aimed at examining if people with cervical spine pain who respond to directional preference exercises will demonstrate an improvement in spinal stability as assessed with the DNFT. In the present study, descriptive statistics were used to assess agreement between two testers for each of the 3 subjects. **Results:** The mean scores among the 4 raters in the 3 subjects ranged from 3.39-3.89 (SD 0.29-0.80). The difference in mean ratings across the 3 subjects was calculated according to an average of 4 trials of the DNFT. The average range of difference among raters was 1.0 for Subject 1, 0.36 for Subject 2, and 0.28 for Subject 3. These results lent support for the student raters to be considered for participation in a larger clinical trial during their clinical internship in the third year of the program. **Conclusions:** The current study suggests practice time, random practice, demonstration, feedback, and reflection led to psychomotor skill acquisition in the performance of the DNFT in 4 DPT students. Their performance allowed them to participate in a clinical trial that includes measurements obtained through the DNFT.

Key Words: deep neck flexors, feedback, psychomotor training

INTRODUCTION

Nonspecific neck pain is a musculoskeletal condition that affects an increasing number of individuals.[1] Neck pain continues to affect about 30% to 50% of the general population with the highest prevalence affecting middle-aged individuals.[2] People who experience spinal pain are 2 to 3 times more likely to report limitations in work, fitness, and social activities demonstrating the debilitating effects of neck pain on overall health.[2]

Physical therapists use a variety of special tests to evaluate people with neck pain. Special tests created to specifically examine the neuromuscular activation and endurance of the deep neck flexor muscles often correlate with functional ability and pain levels for patients who report neck pain. The craniocervical flexion test (CCFT) represents one special test designed to assesses the neuromuscular control of the deep neck flexor muscles.[3,4] Jorgensen et al[3] reported that the intraclass correlation coefficient (ICC) for the inter-rater reliability of the CCFT ranged from 0.63 to 0.82 and the intra-rater reliability of the CCFT ranged from 0.70 to 0.86. They determined that the CCFT is a valid measure due to high minimal detectable change values and results that correlated with outcome scores such as the Numeric Rating Scale and Neck Disability Index.[3] While the results presented for the CCFT seem to support the use of the test, the clinical utility of the test is not practical due to the need for the specialized pressure biofeedback cuff and an extensive amount of trials that most clinicians would not have adequate time to perform. The deep neck flexor test (DNFT) also assesses the neuromuscular activation and endurance of the deep neck flexor muscles (Figure 1).[5-7] Olson et al[6] reported that the inter-rater reliability for 27 individuals without a history of neck pain was 0.83 - 0.88 and the intra-rater reliability for the same group was 0.78 - 0.85 with $p = 0.001$. Harris et al[5] calculated the inter-rater reliability and intra-rater reliability for 20 subjects without and 20 subjects with cervical pain using values determined by 2 separated clinicians. Relative to the group of subjects without cervical pain, Harris et al[5] determined that the inter-rater reliability values were moderate to good ranging from 0.67 - 0.78 and that the intra-rater reliability values were good to excellent ranging from 0.82 - 0.91. For the group with neck pain, the inter-rater reliability value was moderate with a value of 0.67 and the intra-rater reliability was not determined. Although only moderate values are generally reported for the reliability of the DNFT, because it only requires minimal equipment and limited trials, it may be more clinically appropriate. The purpose of this research involved determining the consistency in performance of the DNFT with DPT students and to describe how the process of obtaining reproducibility was incorporated into the student research process. This study was part of a larger research process.

METHODS

In order to conduct the study on human subjects, approval from the Daemen College Institutional Review Board was obtained.

While the didactic research training prepared the DPT students for study design, analysis, and scientific writing, enhanced

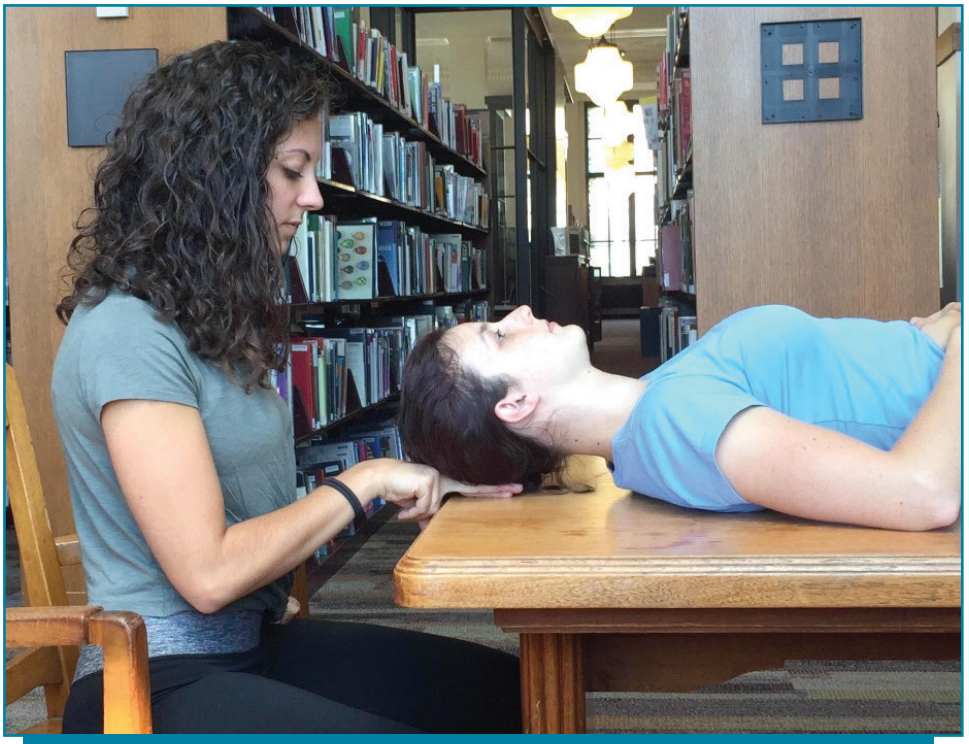

Figure 1. Deep neck flexor test procedure.

psychomotor skill was required to participate in a larger investigation. For the purposes of this study, a model for psychomotor training was adopted from a study conducted by Wise et al[8] on teaching spinal manipulation to DPT students. In that study, a cohort of 15 DPT students in their final semester of entry-level professional training participated in an active training session emphasizing a sequential partial task practice (SPTP) strategy in which participants engaged in partial task practice over several repetitions with different partners. Participants' level of confidence in the performance of these techniques was determined through comparison of pre- and post-training session surveys and a post-session open-ended interview which suggested that this model was effective in changing overall participant perception regarding the effectiveness and safety of these techniques and increasing student confidence in their performance. Interviews revealed that participants greatly preferred the SPTP strategy. A similar process was used to train the DPT students in the performance of the DNFT for this study. Within this model are 3 distinct phases of learning: (1) the preparation for learning phase, which is designed to prepare students for the active learning experience; (2) the active learning phase, which focuses on developing skill through practice; and (3) the evaluation of learning phase, which ensures that psychomotor learning has occurred. Each of the individual learning experiences targets a variety of learning domains and learning phases.[9]

In preparation for clinical testing for reproducibility of the DNFT, the DPT students underwent psychomotor training that included demonstration, blocked, repetitive and random practice, feedback, and reflection. This training took place for 2 hours per week over 3 weeks.

Following the 3 weeks of psychomotor training, the DPT student researchers administered the DNFT with 4 volunteer subjects in the absence of clinician observation. These trials were officially documented and used for analysis of the reproducibility of the DNFT (Table 1).

The test was administered as described in the literature[5-7] as follows: Before testing, the subject was given a detailed explanation of the testing procedure, then was placed in the test position which was crook-lying on a plinth. The subject's head was placed in upper cervical flexion by the examiner who placed stacked fingers under the subject's occiput. The subject was tested twice on the first day of testing, with a 3-minute rest between tests and was given verbal and tactile feedback during the test to help maintain the correct test position, as well as that if any discomfort was produced or increased, the test would be terminated.

In terms of target movement, the subject was asked to gently flex the upper neck and lift the head off the examiner's stacked fingers while maintaining upper neck flexion. Verbal cueing such as "tuck your chin in" or "hold your head up" was given to the subject when the occiput touched the examiner's stacked fingers. The test was terminated if the subject was unable to maintain the position of the head off the examiner's hand or if excessive shaking of the subject's head was seen by the examiner. The holding time was measured in seconds with a stopwatch.

A total of 4 sessions were completed with each of the subjects. In preparation for the task, the students were asked to describe a script to the subject regarding the test procedure to be performed. Peer assisted learning and feedback enhances the accuracy and confidence of psychomotor skills.[10] Therefore, after the recording of each practice session the examiners discussed the criteria for terminating the DNFT that may have included participant discomfort, shaking, or loss of control.

RESULTS

The mean scores among the 4 raters in 3 subjects ranged from 3.39-3.89 (SD 0.29-0.80). The difference in mean ratings across the 3 subjects was calculated according to an average of 4 trials of the DNFT. The average range of difference among raters was 1.0 for Subject 1, 0.36 for Subject 2, and 0.28 for Subject 3.

DISCUSSION AND CONCLUSION

The mean score among the 4 raters in the 3 subjects was considerably lower than that previously described in the literature.[5-7] Harris et al[5] arrived at a significantly different mean deep neck flexor hold time of 38.95 seconds (SD=26.4) for a group without neck pain and 24.1 seconds (SD=12.8) for a group with neck pain. The methods used to determine the reliability of the DNFT with the DPT student raters in this trial included terminating the counting if the subject's head began to excessively shake. Given that the students were aware that all 4 subjects had a history of neck pain (but no present symptoms or treatment), the students may have erred on the side of caution when administering the test. It is noted that during psychomotor training sessions, the DPT students frequently practiced counting out-loud together and discussed what constituted an excessive shake. This may account for the consistency they demonstrated in terminating the test.

Lee et al[11] determined that immediate quantitative feedback via a pressure sensor

Table 1. Deep Neck Flexor Test Trials

Participant 1				
Day 1	Student 1 Examiner	Student 2 Examiner	Student 3 Examiner	Student 4 Examiner
Trial 1	3	2	3	4
Trial 2	4	2	4	4
Trial 3	4	1	3	5
Trial 4	4	1	3	4
Day 2				
Trial 1	3	3	3	3
Trial 2	0	0	0	0
Trial 3	5	4	4	5
Trial 4	3	4	3	4
Day 3				
Trial 1	3	5	5	5
Trial 2	4	4	3	4
Trial 3	6	5	6	7
Trial 4	3	3	3	4
Day 4				
Trial 1	6	4	4	6
Trial 2	10	8	5	7
Trial 3	5	4	5	5
Trial 4	4	3	3	4
Participant 2				
Day 1	Student 1 Examiner	Student 2 Examiner	Student 3 Examiner	Student 4 Examiner
Trial 1	4	2	3	4
Trial 2	2	3	4	3
Trial 3	4	3	3	6
Trial 4	3	2	2	3
Day 2				
Trial 1	4	3	5	6
Trial 2	2	2	4	5
Trial 3	3	3	4	4
Trial 4	5	3	3	4
Day 3				
Trial 1	3	3	3	4
Trial 2	2	4	3	5
Trial 3	2	5	3	5
Trial 4	4	3	3	4
Day 4				
Trial 1	5	4	5	5
Trial 2	3	4	4	4
Trial 3	2	2	3	3
Trial 4	2	3	3	3
Participant 3				
Day 1	Student 1 Examiner	Student 2 Examiner	Student 3 Examiner	Student 4 Examiner
Trial 1	5	3	4	5
Trial 2	3	2	4	4
Trial 3	4	2	4	5
Trial 4	4	1	4	6
Day 2				
Trial 1	4	2	3	4
Trial 2	3	3	4	5
Trial 3	4	3	3	3
Trial 4	1	2	3	2
Day 3				
Trial 1	3	3	3	4
Trial 2	2	2	3	3
Trial 3	2	2	2	2
Trial 4	2	2	3	2
Day 4				
Trial 1	4	3	3	4
Trial 2	2	2	3	3
Trial 3	2	2	3	3
Trial 4	3	1	3	4

provided to DPT students improved their ability to appropriately learn and perform the spinal manipulation. The present study also used quantitative feedback during the trials, which may have been a factor in enhancing technique performance. Practice time was used by the students in preparation for their trials and the literature consistently reflects that the quantity of practice time is a necessary component in the development of a new task.[12]

Correct performance of the test was demonstrated by the clinicians participating in a larger trial. As noted in Wise et al,[8] the typical process for most manual physical therapy lab experiences involves some form of demonstration. Recent literature brings to question whether the demonstration should be done by an expert clinician or a student who is learning. While the expert clinician may provide the most accurate depiction of the skill, research indicates that students gain knowledge by watching a novice attempt the technique and learn from the feedback they receive.[13]

Whether demonstrated by an expert or novice clinician, blocked practice describes a sequence of instruction that allows for repetitive practice of a particular skill or component of the skill until the student achieves mastery.[8] Conversely, random practice involves practice of different tasks on consecutive trials. Although blocked practice is best for acquisition of a new task, such as learning the intricacies of spinal mobilization, random practice has traditionally been considered better for retention and transfer and was the strategy used in the present study.

Aside from the quantity of practice time, feedback is considered to be the most important variable influencing skill acquisition.[14] Intrinsic feedback is provided by sensory systems during performance of a task while extrinsic feedback is provided by the instructor and is supplementary, not inherent, to the task. Extrinsic feedback is considered to be most effective for skill acquisition when the instructor withholds the feedback intermittently.[14] Frequent, immediate extrinsic feedback may actually discourage participants from attending to their own sensory feedback and limit the process of independent solution retrieval that leads to learning. When extrinsic feedback is faded, the instructor provides less and less guidance and direction as the student acquires the skill.[12] The feedback provided in this study most closely resembled the latter.

The final component to skill acquisition is the participant's ability to engage in ongo-

ing self-reflection[15] and in this investigation, the students were given the opportunity to reflect between the practice sessions and also encouraged to continue to learn even after the learning experience. Experts continue to learn even after the conclusion of a learning experience. The results of this study further suggest that physical therapy instructors should consider the value of post-encounter self-reflection and provide mechanisms for learners to continue the process of learning, even after the active learning session is finished.[16]

Another limitation to the study was that the DPT students only recorded results for subjects without current symptoms. Future research studies examining the reliability of DPT students with various examination procedures should include subjects with pain in order to determine the most applicable results to the patient population that the students would be working with in the clinical setting.

The DPT student researchers demonstrated an acceptable level of agreement when administering the DNFT with student volunteers. The DPT student researchers theorized that the reliability occurred initially due to the clinician instruction and quantitative feedback, followed by the combination of repeated and random practice with peer and mentor feedback. The results suggest that further instruction in what constitutes halting of the DNFT will need to be included if the students were to participate in a larger trial.

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