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Electromyographic Analysis of Sit to Stand Dependent Transfers with and without Education on Lifting Technique

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This Scholarly Project, submitted by Jordan Braun, Samantha Stegman, and Alex Wohl in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Graduate School Advisor)

(Chairperson, Physical Therapy)

PERMISSION

TITLE: Electromyographic Analysis of Sit to Stand Dependent Transfers With and Without Education on Lifting Technique

DEPARTMENT: Physical Therapy

DEGREE: Doctor of Physical Therapy

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Signature , SPT
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Date 11-05-14

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ABSTRACT

PURPOSE: The purpose of this study was to assess if there was a change in electromyography (EMG) activity in the back or leg muscles when performing a dependent sit-to-stand lift before and after a brief proper lifting intervention.

SUBJECT: The subjects in this study included 10 female third-year doctoral physical therapy students from the University of North Dakota that were all in good health with no significant pathology of either their backs or lower extremities.

INSTRUMENTATION: The EMG activity was recorded by the Noraxon™ TeleMyo 2400R G2 transmitter and a TeleMyo 2400 SG150 unit. Knee flexion was recorded via a Biometrics™ Ltd Goniometer SG150.

PROCEDURE: The EMG activity was measured using surface electrodes over the right paraspinals, right quadriceps, and right hamstrings. An electrogoniometer was placed over the lateral portion of joint line of the right knee to capture knee flexion. Participants were instructed to perform a dependent sit-to-stand lift with no education on proper body mechanics to establish a baseline reading of muscle activity. EMG electrodes collected muscle activity that was generated during the dependent lift. Following education of proper body mechanics the procedure was repeated using the same dependent lift.

DATA ANALYSIS: MyoResearch XP computer software was used to analyze the EMG activity of each muscle group. The EMG software was given a theoretical maximum voluntary contraction via each muscle group. The EMG data was analyzed in comparison to this maximum voluntary contraction. The EMG data is analyzed through the entire lift.

RESULTS: The noteworthy results for this study conclude that on average the baseline maximum voluntary contraction of quadriceps was 41.60%, while the baseline maximum voluntary contraction of paraspinals was 93.07%. Following intervention, the maximum voluntary contraction of the quadriceps was 52.39%, while the maximum voluntary contraction of the paraspinals was 77.52%.

CLINICAL IMPLICATIONS: The results of this study indicate that following a brief training session on proper lifting technique, third-year physical therapy students demonstrated reduced EMG activity in paraspinal muscles and increased activity in the quadriceps muscles as compared to pre-training lifting.

CHAPTER I

PURPOSE

Transferring a dependent patient is a skill that all student physical therapists will learn and is a critical part of physical therapy practice. This is a skill that must be able to be repeatedly done properly and safely. Like the rest of the country, physical therapists are prone to back problems especially with the addition of incorrect body mechanics in transferring patients. The purpose of this study was to see if there was a change in body mechanics and EMG activity of the paraspinals, quadriceps, and hamstring muscles in the transfer of a dependent patient following a brief instruction on proper body mechanics.

CHAPTER II

METHODS

SUBJECTS: The subjects in this study included 10 female, third-year doctoral physical therapy students from the University of North Dakota. All of the subjects were in good health with no significant pathology of either their backs or lower extremities. The subjects ranged in age from 23-38 years of age, with an average age of 25.3 years old. The subjects' heights ranged from 64-71 inches, with an average height of 66.6 inches. The subjects ranged in weight from 129-170 pounds, with an average weight of 146.1 pounds. All subjects volunteered for the study and signed a consent form. All subjects, as per the curriculum of the physical therapy program at the University of North Dakota, had previously received graduate school level training in proper lifting techniques.

INSTRUMENTATION: The EMG activity was recorded via the Noraxon™ TeleMyo 2400R G2 transmitter and a TeleMyo 2400 unit. Knee flexion was recorded via a Biometrics™ Ltd Goniometer SG150.

PROCEDURE: EMG activity was recorded from the right paraspinals, right quadriceps, and right hamstrings. All electrodes were placed by the same researcher. Two electrodes were placed for each of the three locations, approximately one inch apart, with a ground electrode being placed over the sacrum. All electrodes were placed after several (3) swipes of sand paper and then several (3) swipes of alcohol to clean the area for maximum adherence and data transfer. The electrodes were placed by the following procedure (Figure 1):

Paraspinals: The L3 spinous process was found. The electrodes were placed 4cm to the right of this point in the bulk of the muscle body.

Quadriceps: The midpoint of a line from the anterior superior iliac spine and from the top of the superior pole of the patella. This was the placement for the Rectus Femoris muscle.

Hamstrings: The midpoint of a line from the ischial tuberosity to the lateral femoral condyle. This was the placement for the Biceps Femoris muscle.

An electrogoniometer was placed over the lateral portion of joint line of the right knee to capture knee flexion. The subject was asked to stand in a comfortable position with knees locked to zero out the equipment. The subject then performed a squat to insure that all of the equipment was functioning properly.

A theoretical maximum voluntary contraction was obtained for each of the muscle groups using standard manual muscle test procedures.[1]

Paraspinals (Figure 2): The subject was asked to lie prone with their hands placed behind their head in a relaxed position. With the subject's ankles held down on the table, the subject performed a maximum lumbar extension contraction.

Quadriceps (Figure 3): Seated at the end of the table with a gait belt securely fastened to the subject's ankle, as well as, the table, with approximately 70° of knee flexion. The subject performed a maximum knee extension contraction.

Hamstrings (Figure 4): Seated at the end of the table with a gait belt securely fastened to the subject's ankle, with approximately 70° of knee flexion and the researcher bracing himself against a solid surface holding the gait belt. The subject performed a maximum knee flexion contraction.

The height of the dependent transfer table was 49.5cm. The back of the buttock of the researcher, who was to be dependently transferred, was placed 25cm away from the edge of the table. The researcher's, who was to be dependently transferred, feet were generally about 20cm apart at the start of the transfer. This measurement was taken from the most medial aspect of both feet. The researcher's, who was to be dependently transferred, feet were placed flat on the floor and were positioned approximately 43cm away from the edge of the table from the most posterior part their heel prior to the dependent lift. The subject that was to perform the dependent lift was given instructions to keep in time with a metronome that was clicking at 40 clicks per minute. The subject was to perform the lift with one click, taking the entirety of the click interval, then hold the researcher in standing for 5 clicks, and finally sit the researcher back down within one click, taking the entirety of the click interval. The subject performed two lifts prior to the education of proper lifting intervention and then two lifts after the intervention. The education of proper lifting intervention consisted of verbal reminders to the subject to keep a lordotic curve in their back through the entire lift, use their legs as much as possible through the entire lift, and focus on feeling the lordotic curve prior to the lift. Practicing the lordotic curve in standing was incorporated in the education procedure.

DATA ANALYSIS: MyoResearch XP computer software was used to analyze the EMG activity of each muscle group. The EMG software was given a theoretical maximum voluntary contraction via each muscle group. The EMG data was analyzed in comparison to this maximum voluntary contraction. The EMG data is analyzed through the entire lift.

CHAPTER III

RESULTS

The results of this study found that on average the percent of maximum voluntary contraction of quadriceps was 41.60%, while the baseline percent of maximum voluntary contraction of the paraspinals was 93.07%. Following the training session of proper lifting technique, the percent of maximum voluntary contraction of the quadriceps was increased to 52.39%, while the percent of maximum voluntary contraction of the paraspinals was reduced to 77.52%. These were the noteworthy results of the study. The percent maximum voluntary contraction for the hamstrings of the baseline lift was 72.66%. Following training, the percent of maximum voluntary contraction for the hamstrings was reduced to 62.13%.

CHAPTER IV

CONCLUSIONS

The use of patient education is a key component of nearly any physical therapy intervention. Education can also be useful when performing dependent lifts in both physical therapists and physical therapy students alike. Back injuries are quite prevalent in the United State's health care work force personnel. Those who practice physical therapy, even with years of practice and specialized training, are no exception to this rule. If we can alter the biomechanics and reduce strain on the back muscles when performing lifts, we can there-by reduce back injuries, especially in the physical therapy profession, which tend to perform frequent required lifts.

In order to prevent these back injuries, it may be useful to have frequent brief inter-professional training sessions on proper lifting techniques prior to a day of work. It also may be useful to have frequent brief inter-professional training sessions during the day of work. In addition to these training sessions, providing a mental rehearsal and brief self-intervention could reduce the strain that professionals place on their back through their day and through the entirety of their career as a physical therapist. The results of this study indicate that brief training sessions on proper lifting technique can alter biomechanics and reduce back muscle activity in persons who have previously been formally educated on proper lifting technique.

Figure 1. Subject Set-up.

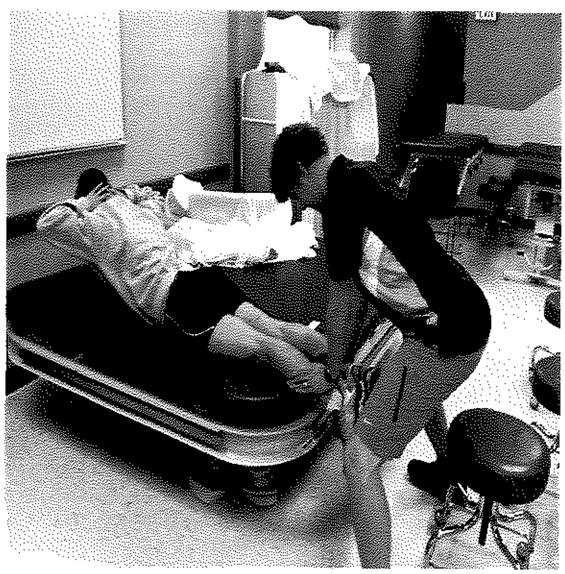

Figure 2. MVC Paraspinal Muscles.

Figure 3. MVC Quadriceps.

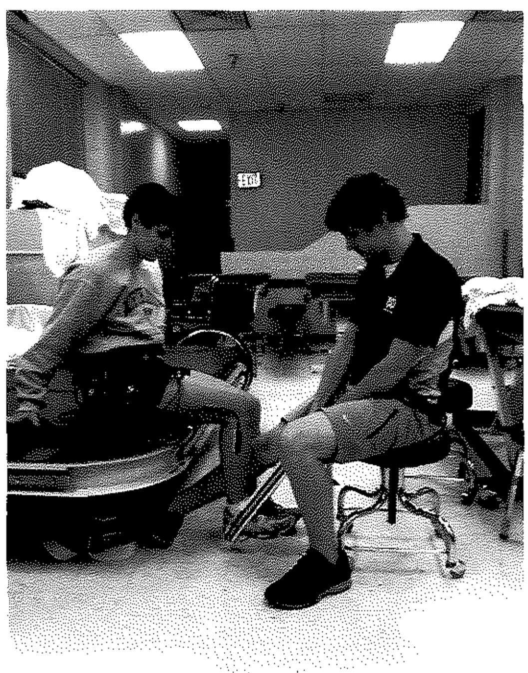

Figure 4. MVC Hamstrings.

Figure 5. Starting Position for the Dependent Sit to Stand Transfer.

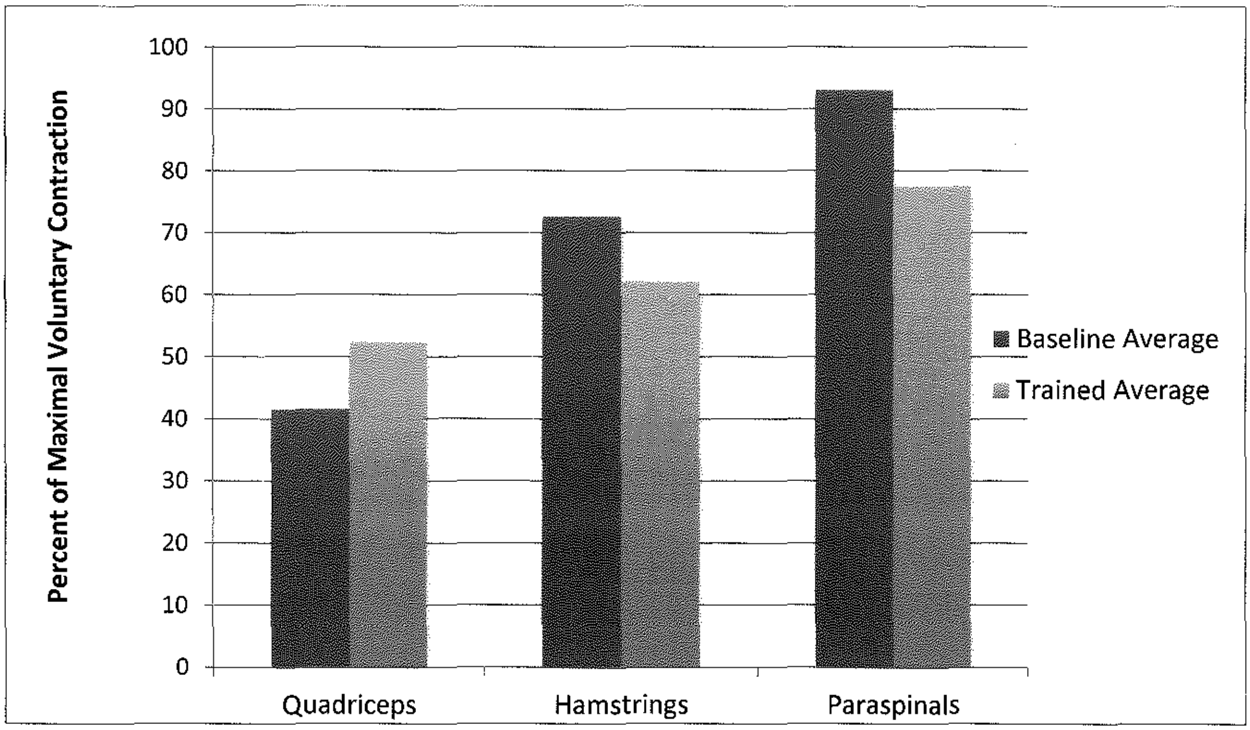

Figure 6. Muscle activity during dependent sit-to-stand transfer. The EMG activity is presented as a percentage of MVC.

APPENDIX

Table 1. Participant Information.

Participant	Age	Height (in)	Weight (lbs)
1	23	64	135
2	23	67	129
3	24	72	165
4	38	65	142
5	24	65	135
6	25	63	135
7	23	67	140
8	23	71	160
9	25	68	170
10	25	64	150
Average	**25.3**	**66.6**	**146.1**

Table 2. Baseline Lift.

Participant	MVC% quadriceps	MVC% Hamstrings	MVC% Paraspinals
1	18.65	90.15	76.5
2	49.75	64.2	61.8
3	16.15	35.0	50.05
4	5.06	56.9	48.4
5	39.85	16.15	69.95
6	97.85	175.0	127.5
7	62.05	65.05	144.0
8	45.35	49.55	143.0
9	NA	138.5	166.0
10	39.65	36.05	43.5
Average	**41.60**	**72.66**	**93.07**

Table 3. Trained Lift.

Participant	MVC% quadriceps	MVC% Hamstrings	MVC% Paraspinals
1	19.5	47.7	58.85
2	39.75	89.3	59.9
3	19.4	33.8	40.7
4	5.24	20.45	31.8
5	76.4	10.7	92.7
6	176.5	144.5	99.9
7	58.2	43.95	90.5
8	54.9	60.35	127.0
9	NA	143.0	123.5
10	21.6	27.5	50.3
Average	**52.39**	**62.13**	**77.52**