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Muscle Activation during Simulated Patient Transfers: Preliminary Study of Experienced versus Novice Patient Handlers

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Muscle Activation During Simulated Patient Transfers: A Preliminary Study of Experienced Versus Novice Patient Handlers

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This Scholarly Project, submitted by Benjamin Mitchell and Patrick Septon 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	Muscle Activation During Simulated Patient Transfers: A Preliminary Study of Experienced Versus Novice Patient Handlers
Department	Physical Therapy
Degree	Doctor of Physical Therapy

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Acknowledgements

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ABSTRACT

Purpose: Back injuries are a common problem in providing health care and manually transferring patients can be a cause of back injuries. Because of this fact, there has been a need for research looking into safe methods for manually transferring patients. The intent of this study was to compare muscle recruitment patterns of novice and experienced health care professionals during a simulated patient transfer. By comparing the muscle activity of the experienced group to that of the novice group, we hoped to see differences that could be used to refine training techniques, thus increasing the safety of novice health care professionals during patient transfers.
Subjects: The experienced group consisted of nine physical therapists/physical therapy instructors and one occupational therapist. The novice group consisted of thirteen first-year students in the UND physical therapy program.
Instrumentation: Electromyographical (EMG) and electrogoniometric data was recorded using a waist belt enclosed Noraxon Telemyo 8 telemetry unit. The signals were collected by the equipment's receiver and then digitized by an analog digital interface board in the Peak Analog Module.
Procedure: All participants were shown the electrode placement and signed an informed consent form. Electrodes were placed over the erector spinae, gluteus maximus, and semitendinosis muscles bilaterally. After a five-repetition maximal lift was determined, the participant performed three trials of transferring a milk crate containing eighty percent of their five-repetition maximal lift weight. All of the lifts were done in a timed sequence with a short break between each trial.
Data Analysis: The EMG data collected was analyzed using SPSS 11.0 for Windows. A 2-Factor ANVOA ($\alpha = 0.05$) was used to compare muscle activity in the Novice and Expert groups. The data was separated into three sections: Rising, Turning, and Descending; as well as by muscle group. Data from the three transfers were averaged for each participant before comparison.
Results: No significant interaction was found between the groups and their muscle activation for any phase of the transfer; however if separated, significant differences were found between the groups themselves as well as between their muscle activation. The only significance found was that the right semitendonosis was used more in the expert group than the novice group during the ascending and descending phases of the transfer ($p=.043$).
Conclusion and Clinical Implication: It has been shown in previous research that most injuries occur when the therapist has limited experience. Our data shows that there are differences between the groups and between the muscles that this study was not able to identify. The researchers suspect that the main reason for the inability to identify the specific differences was due to the limited sample size. This suggests that further research is needed to identify specific differences that make more experienced patient handlers less likely to sustain an injury while transferring a patient.

CHAPTER I

LITERATURE REVIEW

The direct and indirect cost of work-related injuries to health care workers such as physical therapists, occupational therapists, and nurses has a profoundly negative impact on the health care industry. The U.S. Department of Labor did a study in 2003 regarding occupational injuries in the United States. Across all industries, "health care and social assistance" ranked second to "manufacturing" in terms of total injuries in 2003 (188,410/908,310 health care injuries/total occupational injuries). "Health care and social assistance" made up 28% of all lumbar injuries across all industries, making them the group with the most reported lumbar injuries (29,690/106,700 injuries).[1]

Meyer and Muntaner[2] performed a statistical analysis of work-related injuries in three different settings of health care workers: home health, nursing home, and hospital-based workers. They found that for hospital-based nursing staff, the incidence of work-related injuries per year is 46/1000, with the mean number of days lost from work per injury being 14, the mean indemnity payment per injury being $817, and the mean medical cost per injury being $797. For nursing home-based health care workers, the incidence of work-related injuries per year is 132/1000, with the mean number of days lost from work per injury being 18, the mean indemnity payment per injury being $909, and the mean medical cost per injury being $969. Home health-based workers were found to have an incidence of work-related injuries per year of 52/1000, having a mean number of days lost from work per injury of 14, a mean indemnity payment per injury of $1523, and a mean medical cost per injury of $1276. Additionally, this study found the biggest percentage of work-related injuries in these three settings of health care to be back injuries (35.7%). Fuortes, Shi, Zhang, Zwerling, and Schootman[2] found that among nursing staff, the average cost of a back injury was $1714.

Cromie, Robertson, and Best[3] report that 91% of physical therapists experience a work-related musculoskeletal disorder at some time during their careers; and Holder et al.[4] found that among members of the American Physical Therapy Association, both physical therapists and physical therapist assistants reported the lower back as the most common site of an occupational injury. Molumphy et al.[5] report that 29% of physical therapists experience work-related lower back pain. With these statistics, it is easy to see that work-related injuries in the health-care business happen frequently enough to impose staggering costs to the business, not only in direct monetary terms, but also in terms of indirect costs such as days lost from work and decreased productivity for the facility.

Since the back is the most common site of a work-related injury in the health care industry, the biomechanical and motor control changes that result from lower back pain deserve some attention. According to Ebenbichler et al.[6], back extensor strength and endurance decrease in subjects who experience acute or chronic lower back pain. Initial changes in activation patterns after injury cause some muscles to become inhibited while others become hypertrophic. Ebenbichler et al.[6] go on to report that Hides et al.[7] found that ipsilateral multifidus atrophy is evident as soon as 24 hours after the onset of lower back pain. These changes can result in imbalances, postural changes, and altered activation patterns long after the initial injury has healed. Chronic low back pain patients also have been shown to exhibit decreased postural stability, impaired balance, slower reaction time of trunk muscles, and delayed feed-forward activation of abdominal stabilizers.[6] These long-term changes could theoretically place individuals who have sustained one back injury at greater risk of sustaining subsequent injuries.

One particular activity that places health care workers, particularly physical therapists, at risk of sustaining an injury at work is manually transferring a patient from one surface to another. If proper body mechanics are not used, the health care worker may have an increased risk of sustaining an injury while performing the transfer. The U.S. Department of Labor's 2003 study reports that "worker motion or position" was the second most common source of occupational injury across all industries (202,800/1,315,920 injuries), and was also the second most common source of lumbar injuries (25,250/144,650 lumbar injuries). "Healthcare patient" was the third most common cause of lumbar injury (15,980/144,650).[1]

Holder et al.[4] report that the highest prevalence of lower back injury was reported to occur in the rehabilitation practice setting, and the three most prevalent activities being performed at the time of injury were transferring a patient, lifting, and responding to unanticipated/sudden movement by a patient. The most common injury type reported was muscle strain. In 2003, Rugelj[8] performed a study in the Republic of Slovenia and found that 73.7% of the physiotherapists there had experienced lower back pain. The only triggering factor for this lower back pain was found to be handling of dependent patients.

A significant amount of controversy has arisen as of late involving the implementation of "no-lift policies" in health care facilities. It is supposed that using machines for most patient-handling techniques lessens the risk of injury to the health care provider. In 1999, Marras et al.[9] called the manual patient transfer "an extremely hazardous job that had substantial risk of causing a low-back injury". The researchers performed a study using a low-back disorder risk model and a theoretical biomechanical spinal loading model to reach this conclusion. In 2004, Collins et al.[10] studied the effects of the implementation of a "best practices" program at six nursing homes. The program consisted of employee training and utilization of new mechanical lifts and repositioning aids, and a policy of no manual lifts. The study found that implementation of the program significantly reduced the incidence of injury in the nurses at these nursing homes.

However, some evidence shows that proper training in patient handling techniques may reduce the risk of injury during a patient transfer. In 2001 Danyard et al.[11] concluded that the use of mechanical assistive devices for patient transfers may not always be the best way to avoid injury. Two groups of nurses were instructed regarding safe lifting techniques, one of which was also taught to use new mechanical lifts and told to use a zero-lift policy. A control group continued to transfer patients as they always had. In some cases, transfers with mechanical lifts took significantly longer to perform, exposing the nurses using them to significantly higher cumulative spinal loading. The group who continued to perform manual transfers after training experienced significantly lower peak spinal loading than the control group. In 2003, Schibye et al.[12] looked at the differences in lower back mechanical load between self-chosen and recommended patient-handling techniques using a dynamic three-dimensional biomechanical model of the body. In five of the eight patient-handling tasks studied, a significant reduction in spinal loading was seen with application of the recommended technique.

One of the primary goals for most patients in the rehabilitation setting (for example, patients who have suffered a cerebrovascular accident) is to promote as much independence as possible. Having as much independence as possible in activities such as walking or transferring from surface to surface increases the patient's ability to live independently and perform activities of daily living independently. According to Duesterhaus Minor and Duesterhaus Minor,[13] the goal of increased independence can be achieved by the therapist providing verbal cues and manually assisting as the patient performs a transfer (for example, the patient going from sit to stand or stand to sit). The idea is that, through training and gradually decreasing assistance, the patient will progress from dependent to assisted movement to independent movement. They go on to state that direct contact with the patient is important because the therapist's manual contacts can be used to provide input to the patient concerning the direction of movement. This assists the patient in determining the proper direction of movement during the transfer, and facilitates active participation by the patient.

Moody et al.[14] found that nurses are reluctant to use mechanical lifting aids due to decreased patient safety and comfort. This study reported that most patients are strongly opposed to being lifted by mechanical means because they feel degraded, as well as unsafe in the equipment.

In certain situations, such as a building fire, a patient may have to be lifted/transferred regardless of whether a mechanical lifting aid is available, in which case a healthcare practitioner would have no choice but to manually lift a dependent patient.

Additionally, if a patient who is unable to move is in a condition where he or she must get to the bathroom, or if he or she is at risk of developing pressure sores, the patient must me moved. In the case of unavailable or malfunctioning mechanical lifting aids, it would be unethical and unlawful for a healthcare practitioner to not manually assist in moving the patient. [15] These reasons alone should necessitate the training of all healthcare practitioners in proper body mechanics for a patient transfer.

Cromie, Robertson, and Best[3] report that younger physical therapists experience a higher prevalence of work-related musculoskeletal disorders than older therapists. A likely reason for this is a difference in patient-handling techniques between novice therapists and their more experienced counterparts.

It is the purpose of this study to determine whether there is a difference in muscle activation patterns between novice and experienced patient handlers during a simulated patient transfer. A similar study was conducted by Keir and MacDonnel[16] in 2004. This study looked at the difference in muscle activity between novice and experienced patient handlers during transfer of an actual patient. Electromyography (EMG) measurements of the activity of Latissimus Dorsi, upper Trapezius, upper Erector Spinae, and lower Erector Spinae were recorded. The study compared the EMG data of transfers from bed to wheelchair with that of transfers from wheelchair to bed and found that the data was similar. In all transfers, experienced patient handlers had the same or slightly less EMG activity in upper and lower erector spinae, and higher EMG activity in latissimus dorsi and trapezius when compared to novice patient handlers.

Noe et al.[17] studied competitive weightlifters versus inexperienced control subjects performing an isokinetic dead lift. They found that the experienced weightlifters tended to use the gluteus maximus more during the early stages of the lift. They go on to discuss that this process would stabilize the pelvis and permit the erector spinae to extend the trunk more efficiently.

As stated above, the current study is similar to the Keir and MacDonnel study[16], but also uses ideas from the Noe et al. [17] study, in that the focus is more geared towards lower body mechanics. This study focuses on the activity of the lower erector spinae, gluteus maximus, and semitendinosis. Electrode placement in this study over the above muscles was according to the guidelines of Cram, Kasman, and Holtz.[18]

The purpose of this study is to gain potentially valuable information regarding experience-related changes in muscle activation patterns during the action of transferring a patient. The researchers hope that the results of this study and others like it can be used to create better techniques for the training of physical therapists and other healthcare workers in performing safe patient transfers. Ideally, better training techniques would lower the incidence of injuries sustained while transferring a patient, especially in younger, less experienced health care workers who are more prone to injury. The information gained from this study could theoretically also be generalized to professions outside the healthcare world where lifting injuries are prevalent.

CHAPTER II

METHOD

Participants

Participants for this study were obtained on a voluntary basis from the University of North Dakota (UND) Physical Therapy department and area healthcare facilities. To be included in the study all participants had to be between 19 and 50 years of age. The reason for this was to remain above the legal age limit for minors, incorporate age groups representative of practicing physical therapists, and control for decreased muscle strength associated with aging. Any participants with reports of back injuries during the past year were excluded from the study as this has been shown to change the muscle performance of the back.[6-7] All participants completed an informed consent form (Appendix A) and viewed a diagram (Figure 1) showing were the electrodes would be placed. The Participant was also informed that the diagram (Figure 1) shows electrodes on one side of the body but this study would use electrodes on both sides of the body, an additional electrode would be placed over the spinus process of C_7, and that an electronic goniometer would also be placed over their right hip. Participants were required to fill out a participant questionnaire before participating in the study (Appendix B). The questionnaire was intended to gather demographic information, inclusion criteria, and risk factors that may exclude the participant from the study.

In all, 23 individuals participated in this study and were separated into two groups. Novice participants came from the first year physical therapy class at UND shortly after they had received training in proper techniques for transferring patients. A total of thirteen first year UND physical therapy students (6 women and 7 men) participated in this study.

The Expert participants were Physical Therapists, Physical Therapy Instructors teaching transfers, and Occupational Therapists with at least one year experience teaching, working in an acute or rehabilitation facility, or in home health. All of these positions required the therapist to perform patient transfers several times a day or teaching others how to perform patient transfers. In all, ten participants were placed into the Expert group (eight female physical therapists, one male physical therapy instructor, and one female occupational therapist).

Instruments

Electromyographical (EMG) signals were collected using surface electrodes placed over the Erector Spinae, Gluteus Maximus, and Semitendinosus muscles bilaterally (See section on electrode placement). An electronic goniometer was placed over the participant's right hip to record the amount of motion at the hip during the transfer. The signals were then recorded using a waist belt enclosed Noraxon Telemyo 8 telemetry unit (Noraxon USA, 13430 North Scottsdale Rd., Scottsdale, AZ 85254). The signals were collected by the equipment's receiver and then digitized by an analog digital interface board in the Peak Analog Module (Paek Performance Technologies, 7388 S. Revere Parkway, Suit 601, Englewood CO 80112-9765).

Electrode Placement

Electrode placement was done behind a screen in the research facility separated from other people. To preserve participant comfort and modesty, someone of the same gender was present as the electrodes were placed on the participant. Figure 1 shows the unilateral view for the muscle EMG electrode placement; in this study EMG electrodes were placed bilaterally. Figure 2 shows a participant with all of the electrodes in place and figure 3 shows a close-up view of the Erector Spinae muscles electrodes.

Electrodes for the Erector Spinae muscles were placed vertically about four centimeters lateral of the $L_{4\text{-}5}$ interspace. For the Gluteus Maximus muscles the EMG electrodes were placed at the midpoint of an imaginary line drawn from the inferior lateral angle of the sacrum to the greater trochanter. The Semitendinosus EMG electrodes were placed at the midpoint of an imaginary line drawn from the ischial tuberosity to the medial femoral condyle. The reference electrode was placed on the spinus process of C_7. In addition to the EMG electrodes an electronic goniometer was placed over the participant's right hip to measure hip flexion during the transfer.

Design

The simulated patient used in this study was a milk crate, with handles, that the researchers could place weights in. Before the transfer began the participants performed a five Repetition Maximal Lift (referred to as max lift). The reason for the max lift was to normalize the data from the EMG equipment. The max lift was done using the same box as was used in the study. The participant had to lift the box according to a beeping sound in the back ground (1.5 seconds apart) to insure consistency in lifting speed between participants. On the first beep the patient lifted the box, held the box at waist height during the second beep, returned the box during the third beep, waited with the box down during the fourth beep, and repeated until five repetitions were met. Weight was increased in the box until the participant was showing signs of substituting or the participant reported that they couldn't lift anymore weight. A rest period of three minutes was taken between each attempt. During the testing 80% of the participant's max lift was used to increase the safety of the participant during the transfer.

The transfer performed was a standing pivot transfer, a technique used when the patient is able to do some weight bearing and needs to be transferred to another surface, for example from a wheelchair to a mat table or chair. The surfaces in this study were two chairs placed 90° to each other. The height of both surfaces remained constant and equal throughout the study. The participants were allowed to use the handles on the box. All of the transfers were done to the "patient's" right side in order to keep the data received from the participants consistent. Again the beeps were used, as before with the max lift, with a few differences: during the second beep the participant turned to their left and the transfer was only done once. The transfer was repeated three times and averaged to ensure consistency of the data obtained. Figure 4 shows a participant as he is entering the Descending phase. Between each transfer and each attempt at a max lift the participant rested for a minimum of three minutes.

The transfers were videotaped to allow both researches to review the techniques used and make observations. The video and the electric goniometer were used to separate the stages of the lift into Rising, Turning, and Descending.

Participants were compensated for their time depending on which group they were in. The participants in the Expert group were entered into a drawing for UND

Men's Hockey tickets. Those in the Novice group were entered into a drawing for a $50 gift certificate to a local restaurant.

Data Analysis

The EMG data collected was analyzed using SPSS 11.0 for Windows. A 2-Factor ANVOA ($\alpha = 0.05$) was used to compare muscle activity in the Novice and Expert groups. The data was separated into three sections: Rising, Turning, and Descending as well as by muscle: Erector Spinae, Gluteus Maximus, and Semitendosis. The highest mean differences between the groups, for each muscle and phase, were also analyzed using an independent samples t-test ($\alpha = 0.05$) to look for specific muscle differences. All data and forms collected were stored securely and separately in a locked file in the UND Physical Therapy Department for three years.

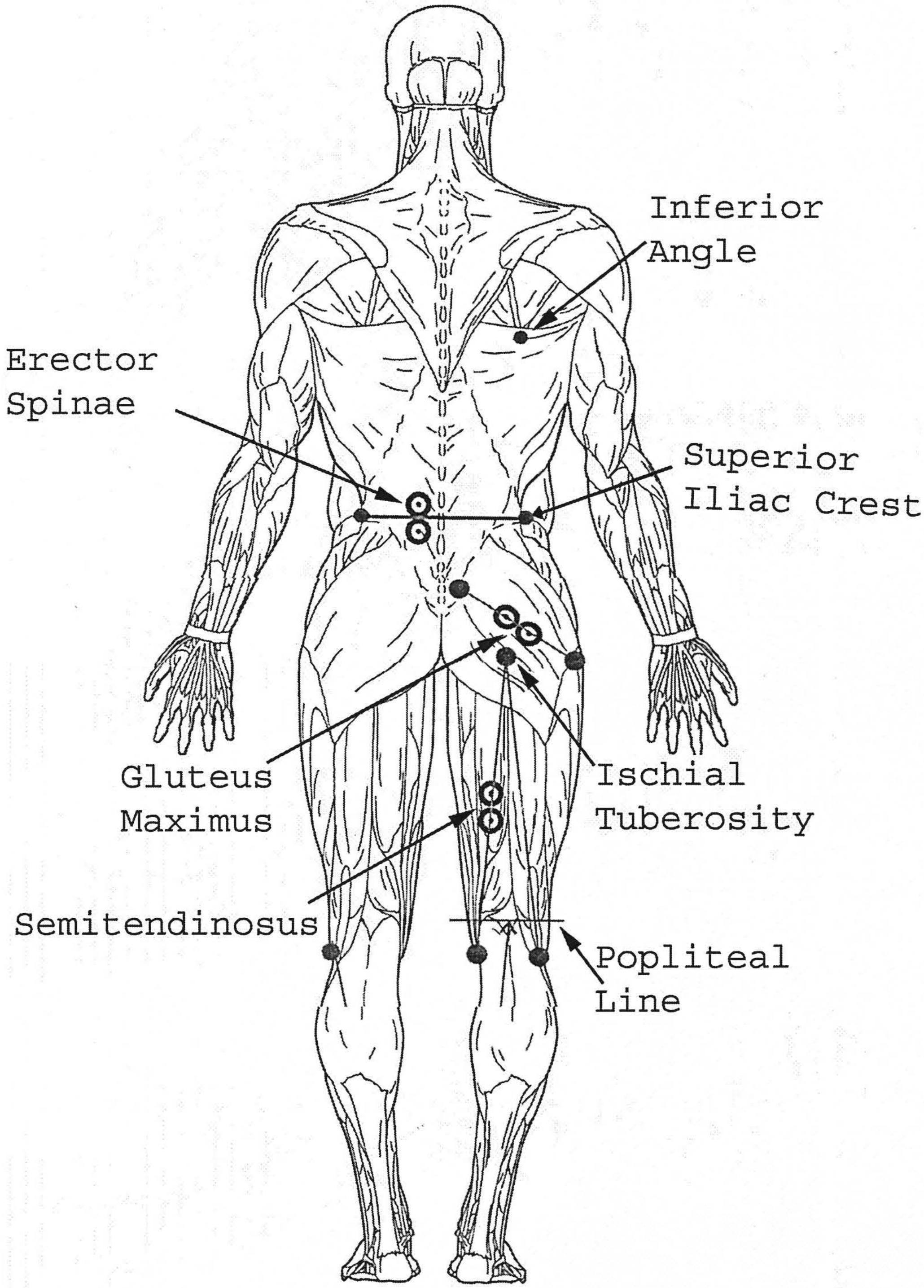

Figure 1: Placement of EMG Electrodes

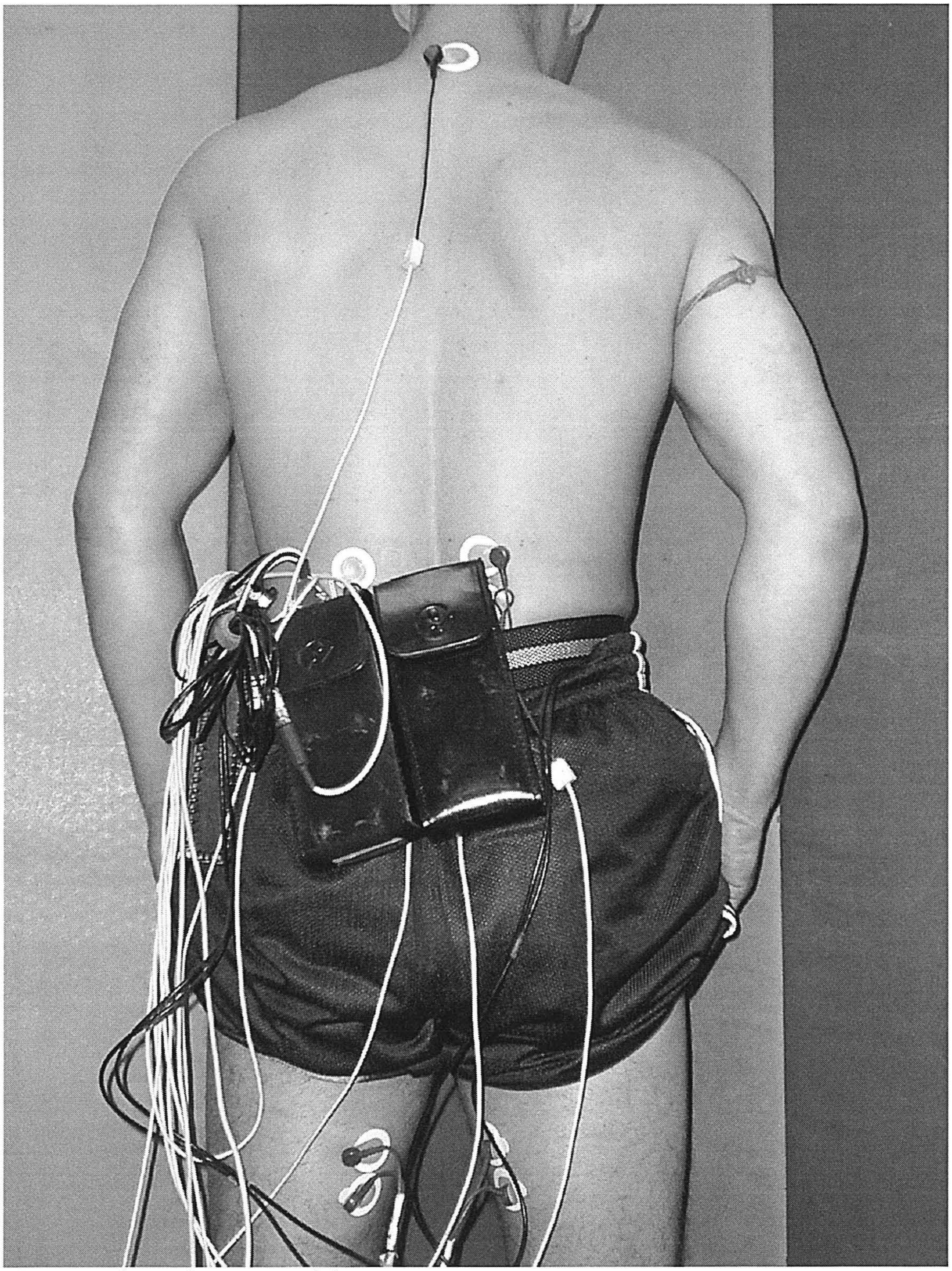

Figure 2: Electrodes on a participant

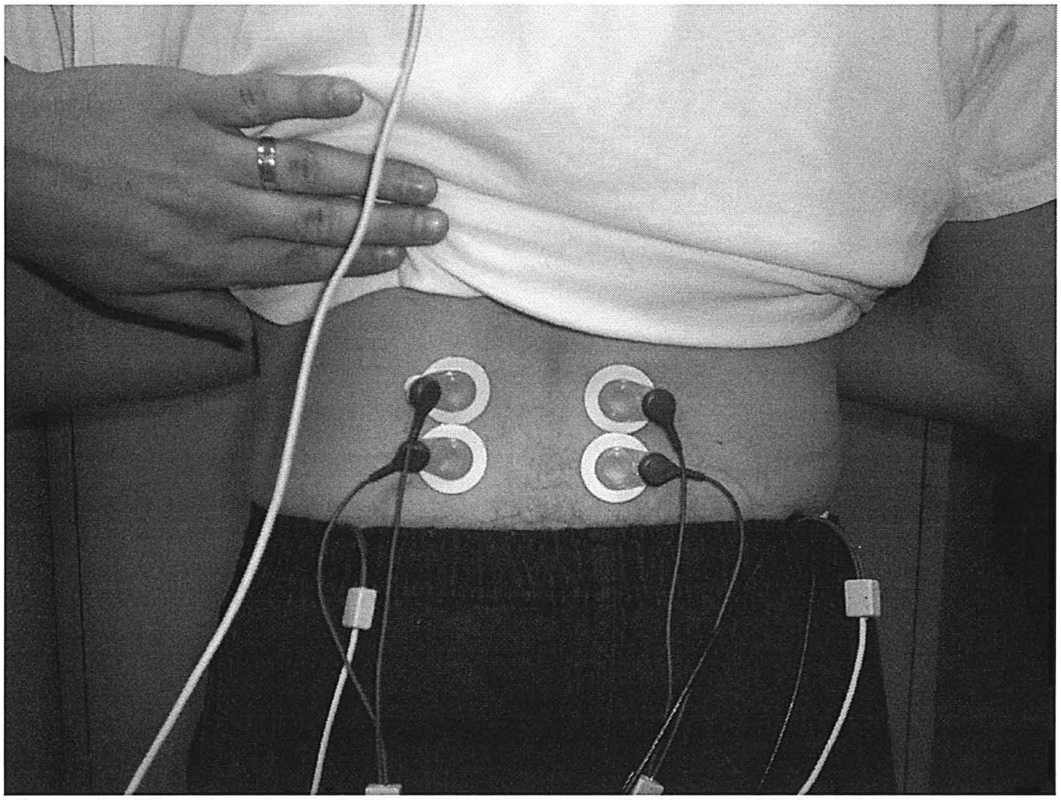

Figure 3: Close-up view of electrode placement for Erector Spinae muscles.

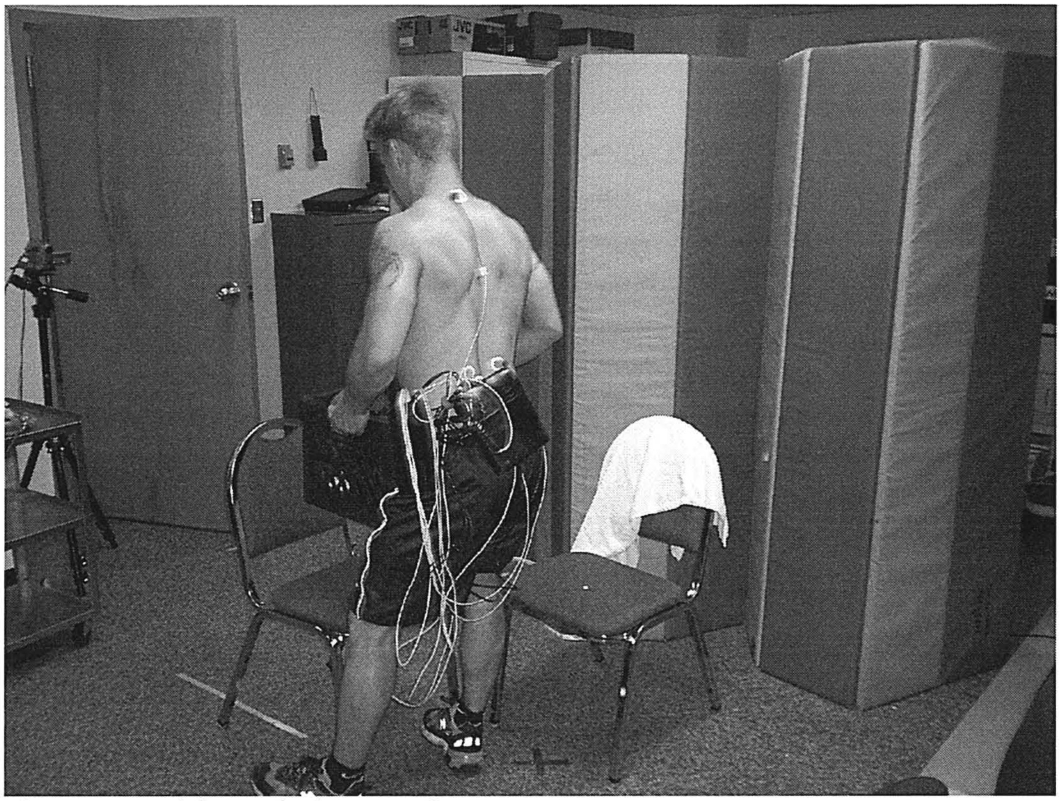

Figure 4: Participant during transfer.

CHAPTER III

RESULTS

Statistics

All statistics were done using SPSS v. 11.0 for windows and were analyzed by the researchers, their advisor, and a faculty member in the University of North Dakota Physical Therapy department with additional research education. Significance was compared with an alpha of 0.05.

Demographics

Data was analyzed from all 23 participants in this study. A total of 13 participants (6 men and 7 women) were included in the Novice group. Ages for this group ranged from 21 to 37 years of age with the mean being 24.5 years. The five repetition maximal lift ranged from 60 to 185 pounds with a mean of 104.8 pounds. The Expert group consisted of 10 professionals (9 women and 1 male) all were physical therapists, physical therapy instructors, or both, with the exception of one occupational therapist. Ages in the Expert group ranged from 26 to 47 years with a mean of 38.5 years. This group's five repetition maximal lift ranged from 45 to 98 pounds with a mean of 60.3 pounds. In order to be included within the Expert group the participants had to have some experience. The experience ranged from 3 to 25 years with a mean of 14 years.

EMG Data Analysis

An independent measure two way ANOVA was used to analyze the EMG data from the two groups. Data from the two groups was collected over a total of six muscle groups: left erector spinae, right erector spinae, left gluteus maximus, right gluteus maximus, left semitendonosis, and right semitendonosis. The transfer was also separated into three phases in order to better understand the mechanics of the lift. The lift was separated into the rising phase, turning phase, and the descending phase. F values and significance for each phase can be seen in Table 1. No significant interaction was found between the groups and their muscle activation for any phase of the transfer; but if separated, significant differences were found between the groups themselves as well as between their muscle activation. The muscle groups, listed in table 3, which had the largest mean difference between the two experience groups (Novice and Expert) were then compared using an independent samples t-test. A list of means and standard deviations for each phase can be found in Table 2. The independent samples t-test did not find any significance in muscle activation between the groups with one exception. The right semitendonosis was used more in the expert group than the novice group during the ascending and descending phases of the transfer ($p=.043$). Table 3 contains the muscle groups tested and their results for the independent samples t-test.

Table 1: Independent Measures Two Way ANOVA Values.

	Rising		Turning		Descending	
	F	Sig.	F	Sig.	F	Sig.
Group	6.622	.011	4.556	.035	15.984	< .001
Muscle	3.923	.002	5.550	< .001	2.857	.018
Group & Muscle	1.032	.402	.874	.500	.314	.904

Table 2: Means and Standard Deviations for Each Muscle and Group for Each Phase of The Lift.

Group	Muscle	Rising		Turning		Descending	
		Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Novice	R Erector Spinae	57.92	13.54	39.32	11.91	47.10	8.91
	L Erector Spinae	57.61	13.60	42.69	13.62	47.18	8.84
	R Gluteus Maximus	65.52	35.43	50.85	34.48	38.46	13.03
	L Gluteus Maximus	55.40	21.45	41.44	15.02	38.18	15.11
	R Semitendonosis	69.95	23.74	59.00	21.20	46.91	17.26
	L Semitendonosis	64.35	17.30	60.09	19.97	51.44	18.68
Expert	R Erector Spinae	62.09	13.40	42.26	14.08	56.28	13.43
	L Erector Spinae	57.64	21.06	41.11	15.85	54.63	16.59
	R Gluteus Maximus	66.17	11.29	69.27	25.20	51.33	29.72
	L Gluteus Maximus	68.96	17.78	56.93	21.34	47.77	21.47
	R Semitendonosis	91.87	24.81	62.81	12.56	64.81	22.71
	L Semitendonosis	79.20	21.20	64.84	20.28	66.64	17.65

Table 3: Results of Independent Samples t-tests for Specific Muscles

Phase	Muscle	t-test	Sig.
Rising	R Semitendonosis	-2.153	.043
	L Semitendonosis	-1.851	.078
	L Gluteus Maximus	-1.614	.121
Turning	R Gluteus Maximus	-1.420	.170
	L Gluteus Maximus	-2.046	.054
Descending	R Gluteus Maximus	-1.403	.175
	L Gluteus Maximus	-1.259	.222
	R Semitendonosis	-2.152	.043
	L Semitendonosis	-1.981	.061

CHAPTER IV

DISCUSSION

Very little significance was found when comparing the muscle activity of expert and novice patient handlers during a simulated patient transfer. The significance that was found was that of the right semitendonosis of the expert group was used more during the ascending and descending phases of the simulated transfer. This significance is also in question as there are those that would argue that when doing a simple means analysis the alpha level should be reduced depending on the amount of factors involved. As our results place the significance fairly close to our alpha level any reduction would have made our findings lose their significance. Also with only one difference found, it cannot be said with any amount of confidence that expert patient handlers use more hip extensors that back extensors during a patient transfer than novice patient handlers.

While the comparison of muscle activation between groups showed little to no significance, each factor alone did show some significance. This signifies that there are differences between the groups and between the muscles that this study was not able to identify. Possible reasons for this are discussed in the limitations section.

Even though this study did not find any significance, other studies have found that experience makes a difference in both how muscles are used,[16-17] as well as preventing injuries.[3] Transferring, while necessary, [13] can be dangerous[7-9] and further research could be useful for making it safer for the therapists. The use of a "no-lift" policy could be one solution[10] but is also very limiting and could be impractical at times.[11, 13-15] In these times the knowledge of safe manual transfer techniques would be required.

Limitations and Considerations for Future Study

Several limitations were noted during this study. The most prevalent being the small sample size used. This was done mostly due to a limited amount of resources but this has caused a great deal of variability within the results. Most of our standard deviations are a large percentage of our mean. This shows that our data is spread out and contains the possibility of having a lot of error. A larger sample size could reduce this error and possibly provide more significant results. Also, comparing two groups has some inherent error involved and while not appropriate for this study, a longitudinal style study could produce clearer results.

Another limitation was reported by the participants. In the study by Keir and MacDonnel[16] a real person was used, but we decided to use the milk crate instead in order to remove the possibility of an unintentional bias. An unforeseen problem arose when several of the expert handlers noted that transferring our simulated patient (the milk crate) did not feel like transferring a real patient. Several participants, from both groups, also had trouble transferring the simulated patient in time with the beeps. They reported that it was unnatural for them to separate the transfer in this way and could have possibly altered their performance. In the future a weighted dummy or other such object may feel more normal to the participant.

Lastly a few of the novice participants stated while talking with the researchers that they lifted weights on a regular bases. A few of them also mentioned that they have been trained in correct techniques for lifting. As reported by Noe et al.[17] competitive weight lifters have a different method pattern for their muscle activation. Observations made by the researchers did note a difference in technique for those individuals that mentioned they had been trained in lifting techniques. In future studies, it is recommended that the training effect for individuals, such as weight lifters, be controlled for.

CHAPTER V

CONCLUSION

Although we were not able to show a specific significant difference in muscle activity we did show that there appears to be a difference between the lifting techniques of expert and novice patient handlers. Back injuries remain a significant problem in health care and research needs to continue to make working with patients as safe as possible. More research in the future may be able to isolate some differences in technique and make the manual transfers of patients safer for everyone.

Appendix A

Information and Consent Form

Title: *Muscle Activation During Simulated Patient Transfers: A Preliminary Study of Experienced Versus Novice Patient Handlers*

You are invited to participate in a research project being conducted by Benjamin Mitchell and Patrick Septon, second year students in the University of North Dakota's Doctor of Physical Therapy program.

The purpose of this study is to outline muscle activation patterns of novice and experienced patient handlers, with the intent of gaining information which could be helpful in determining effective muscle control strategies for patient transfers, evaluating the specific tissues at risk of injury while performing a patient transfer, and developing improved training methods and/or improved techniques for patient transferring.

The study will involve you, the participant, lifting a weighted box from a wheelchair to waist level, and then lowering it back into the wheelchair. Prior to performing this transfer, electromyography (EMG) electrodes will be placed on your skin so that we may record the muscle activity in your body as you perform the transfer. Electrode placement will be over the following muscles, bilaterally: Lumbar Erector Spinae, Gluteus Maximus, and Semitendinosis.

Your participation will require roughly one hour of your time. You will only be participating once, no follow-up participation is required. If you are in the "experienced patient handler" group, you will be compensated by being entered into a drawing for two UND Fighting Sioux men's hockey tickets. If you are in the "novice patient handler" group, you will be compensated by being entered into a drawing for a $50 gift certificate to GF Goodribs, a steakhouse in Grand Forks. Winners will be contacted by phone no later than three weeks after participation in the study.

One possible foreseeable risk to you, the participant, is the risk of sustaining an injury while performing the transfer. The researchers consider this a highly improbable occurrence due to the fact that you have had previous training regarding proper lifting techniques.

In the unlikely event that you are injured while participating in this study, medical treatment, including first aid, emergency care, and follow up care will be available as it is customary to members of the general public in similar circumstances. You and/or your third party payer must provide the cost of treatment.

You may choose to discontinue your participation in the study at any time up until data collection is completed. Should you decide to discontinue or not participate, this will not prejudice your future relationship with the Physical Therapy Department, School of Medicine and Health Sciences, or the University of North Dakota.

Your identity will remain anonymous in any reports of the results of this study. Each participant will be assigned a number; no names will be associated with any of the data records the researchers keep. The data and the consent forms will be stored separately in a locked office in the UND physical therapy department for three years following the completion of this study. People who could have access to these records include the researchers and people who audit IRB procedures. After three years all records will be shredded. Data that is reported will be aggregated.

If you have questions about the research, please call Benjamin Mitchell at (701) 330-2345, Patrick Septon at (701) 740-6555, or Beverly Johnson at (701) 777-3871. If you have any other questions or concerns, please call Research Development and Compliance at 777-4279. If you have any questions now, the researchers would be happy to answer them at this time.

I HAVE READ AND UNDERSTAND THE ABOVE CONSENT FORM AND I HAVE BEEN ENCOURAGED TO ASK ANY QUESTIONS I MAY HAVE. ALL PROCEDURES, INCLUDING PLACEMENT OF ELECTRODES, HAVE BEEN EXPLAINED TO ME IN TERMS I UNDERSTAND.

____

Participant's Signature Date

____

Witness's Signature Date

Appendix B

Participant #:__________________

Date: ________________________

Gender (circle): M F

Age:

What is your primary profession?

How long have you worked at this profession?

Do you have to transfer patients regularly as a part of your profession?

Have you had any back injuries in the past year?

Do you have a history of low back pain? If "Yes" when was your last episode and how often do you have back pain?

Are you currently having any pain, dizziness, weakness, or anything else that the researchers should be aware of?

For Researchers Use:
Group:

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