Knee Joint Angle and Lower Extremity Neuromuscular Analysis in a Geriatric Female Population

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Abstract

PURPOSE: The aim of this research is to examine the effectiveness of a therapeutic intervention on improving lower extremity functional movement in the aging population. A decrease in joint mobility is a significant risk factor in geriatric populations in which falls may lead to fracture and death. Using dynamic therapy, elderly patients may experience simultaneous positive changes in function and mobilization due to increased neuromuscular facilitation.
METHODS: Data was collected on 8 women with a mean age of 87.6 ± 10 years. Subjects participated in a therapeutic exercise program for 6 weeks, 30 minutes per session. The program consisted of a 5 minute warm up, 20-minute resistance and neuromuscular facilitation training, and a 5-minute cool down. A counter movement jump was performed using a 3-D accelerometer (Myotest, Switzerland), and angles were measured in the sagittal plane using Kinovea 2-D video analysis software pre/post intervention.
RESULTS: Jump height was analyzed using a paired sample t-test and correlations between low knee angles (LKA), knee angle differences (KAD), and jump height was analyzed using a Pearson Product Correlation (P≤.05). Jump height ($p<0.047$) improved by 3.31cm ± 3.88 (Figure 2). Significant correlation was found between LKA and KAD r= (-0.874), and LKA and jump height r= (-0.79) (Figure 1).
CONCLUSION: After the therapeutic exercise program jump height significantly improved. Subjects who had a LKA closer to 90° in the jump also had a larger relative KAD between LKA and rest angles, thus more knee mobility demonstrated that participants with a LKA closer to 90° also had a greater jump height (figure 1). Participants who focus on therapeutic intervention may increase jump height (figure 2), demonstrating more neuromuscular innervations and strength gains. These improvements may decrease falls in an elderly population, suppressing fractures and fall related deaths. By increasing neuromuscular activity, strength and knee mobility, lower extremity function will improve.

Introduction

The aim of this research is to examine the effectiveness of a therapeutic neuromuscular intervention on improving lower extremity functional movement in the aging population. According to Wilkerson and Gary B. (2012) immobilization of joints is one of the biggest factors that leads to a decrease in function in the lower extremity. The less mobile a joint is, usually represents a negative correlation to the function on that extremity. This negative correlation is a significant risk factor in geriatric populations in which one fall may lead to fractures and even death. This study has the unique characteristic of identifying how the body angles deteriorate and how they affect lower extremity function. Many other studies look at the ideal angle and muscle formations (Anh-Dung Nguyen 2009). Lower extremity function studies have been conducted on the elderly, but have been conducted about general exercise, symmetry of limbs, tissues, BMI, and muscle strength (Riskowski, J.L. 2012). Few have identified specific degenerative angle or immobilization characteristics in the knee that may occur naturally in the aging process and how they may affect lower extremity function. Using a dynamic therapy intervention, elderly patients may experience simultaneous positive changes in function and mobilization due to increased neuromuscular facilitation. This enables an elderly person to recover from falls quicker and more efficiently. This study can be used to better understand and further prevent deterioration of lower extremity joint angles and motor unit stimulation, and therefore preserve health in an elderly population by preventing falls.

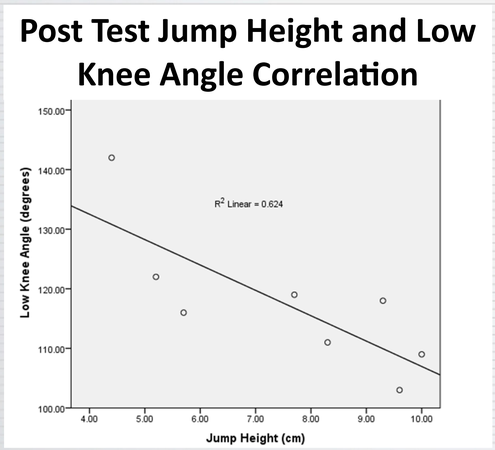

Figure 1

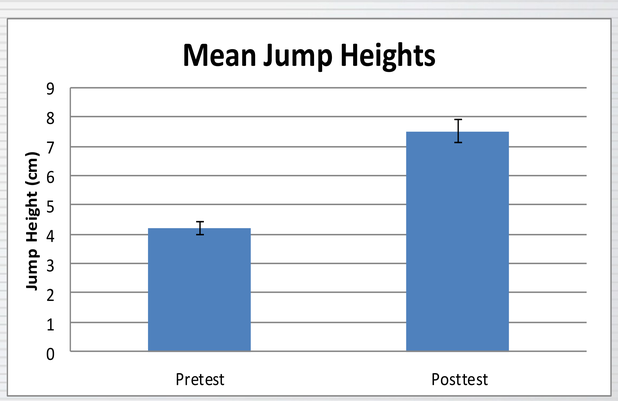

Figure 2

Results

Jump height, pre and posttest knee angle differences (KAD) between rest and low angle positions, and low knee angles (LKA) pre and posttest angles were analyzed using a paired sample t-test (P≤.05). Correlations between LKA, KAD, jump height, low angle positions, angle differences, power, eccentric concentric ratios, and speed were analyzed using a Pearson Product Correlation test (P≤.05) on SPSS (version 19). Jump height ($p\leq0.047$) improved by 3.31cm ± 3.88 (figure 2). Pre and post test KAD between rest and low angle positions; and low position pre and posttest angles did not have significance; p values are 0.154 and 0.159 respectively. Significant correlation was found between LKA and KAD r= (-0.874), and LKA and jump height r= (-0.79) (figure 1). Low angle and height correlation was significant at r=0.79. Eccentric concentric ratio and power correlation was significant at r=–0.923. Power and speed correlation was significant at r= 0.883. Speed and height correlation was significant at r=0.707.

Methods

Data was collected on 8 women with a mean age of 87.6 ± 10 years who were recruited from an independent living community (Presbyterian Homes) in Arden Hills, Minnesota. Participants were only included if they were healthy enough to perform the countermovement jump profile, were over the age of 55, had not sustained a lower extremity injury in the last 2 years, and signed an informed consent. Subjects participated in a therapeutic exercise program for 6 weeks, being required to attend at least two of the three days a week, for 30 minutes per session. The program consisted of a 5 minute warm up, 20-minute resistance and neuromuscular facilitation training, and a 5-minute cool down. A counter movement jump was performed using a 3-D accelerometer (Myotest, Switzerland) both before and after the completion of the therapeutic exercise program. Angles were measured in the sagittal plane with vertex located 5cm lateral of the knee cap using Kinovea 2-D video analysis software pre/post intervention.

Conclusion

After 6 weeks of a therapeutic exercise program, data demonstrates that height was significantly improved from a pretest average of 4.2125 cm to a posttest average of 7.525 cm (figure 2). The study showed that in a population of 85-95 year old female participants, those who had a low angle closer to 90° in a countermovement jump also had a higher angle difference. This means that participants with a rest angle closer to 90° also had a greater jump height (figure 1). Participants who focus on our dynamic exercises will both increase jump height and knee motion showing more neuromuscular innervations. These improvements will decrease falls in an elderly population lowering fracture and fall related deaths. By increasing neuromuscular activity, strength and knee flexion in the lower extremity will improve. Further research needs to be conducted on how to improve knee angles alone.

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