Optimal and Maximal Loads during Hip Adduction Exercise by Asymptomatic People

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Abstract. [Purpose] The purpose of this study was to provide data for decision making regarding the optimal and maximal hip adduction loads for clinical and fitness purposes, respectively. [Subjects] Forty-eight (24 males, 24 females) asymptomatic adults participated in this study. [Methods] Subjects performed optimal and maximal hip adduction loads. Regarding the gender, body weight and height variables, a stepwise multiple regression analysis was used to identify the most informative variables for predicting the optimal and maximal loads during the hip adduction exercise. [Results] The regression model for optimal hip adduction load (kg) was: 34.3 + 0.4 × weight − 0.27 × height ($r^2 = 0.77$); and the regression model for maximal hip adduction load (kg) was: 39.5 + 0.5 × weight − 0.3 × height ($r^2 = 0.75$). [Conclusion] These models can aid in deciding the optimal and maximal hip adduction loads for clinical and fitness purposes, respectively. Thus, the optimal hip adduction load model can be used to strengthen the hip adductor muscles or enhance core stability in clinical settings.

Key words: Hip adduction, Optimal load, Regression analysis

INTRODUCTION

Anatomical cadaver studies have shown that vastus medialis oblique (VMO) fibers originate from the distal part of the adductor magnus. Thus, VMO fibers provide stability during the contraction that occurs in hip adduction. Hip adduction also stretches the VMO fibers, adjusting the length and tension properties of the muscle and increasing the contraction force. Based on anatomical analyses, previous research has shown that hip adductor contraction during squat exercises results in selective strengthening of the VMO. Another study reported that the hip adductor muscle is connected to the internal abdominal muscle through the iliacus, psoas major, and quadratus lumborum muscles. Kim and Yoo reported that the muscle activities of the external oblique, internal oblique, and L5 paraspinous muscles increased during hip adduction using a visual feedback device. Hip adductor muscle contraction also synergistically facilitates the pelvic floor muscle activity that occurs with the contraction of the abdominal muscle. Therefore, many clinicians have used various hip adduction exercises for low back pain, or patellofemoral pain or pelvic muscle weakness patients. The selection of the exercise load is a very important factor in the effectiveness of the exercise. However, hip adduction load studies are few in number. Therefore, in the present study, using regression analysis, we determined the optimal and maximal loads during hip adduction exercise by asymptomatic subjects. The purpose of this study was to provide data for decision making regarding the optimal and maximal hip adduction loads for clinical and fitness purposes, respectively.

SUBJECTS AND METHODS

Forty-eight (24 males, 24 females) asymptomatic subjects with no known surgical, musculoskeletal, or neurological history of any pathological condition in the lower extremities participated in this study. The mean age of the participants was 24.3 ± 4.4 years, their mean height was 169.5 ± 8.4 cm, and their mean weight was 61.2 ± 12.7 kg. This study was approved by the Inje University Faculty of Health Science Human Ethics Committee, and all subjects provided their written informed consent to participation before commencing the study. Subjects were instructed to bend their knees to 45° in a height-adjustable chair and adduct their knees to their hip. Subjects performed optimal and maximal hip adduction loads. The optimal hip adduction load was defined as sustainable load holding for 3 s with maximal effort hip adduction. The maximal hip adduction load was defined as sustainable load holding for 20 s in isometric hip adduction isometric exercise. The maximal hip adduction load was defined as sustainable load holding for 3 s with maximal effort hip adduction. The hip adduction load was measured by PowerTrack II (JTECH Medical, Salt Lake City, UT, USA). Hip adduction load measures were performed using an air cushion with the PowerTrack II placed between the medial joint lines of the knees. The air-cushion was volume-adjustable. Thus, excessive hip add-
duction motion could be controlled. The individual optimal and maximal hip adduction load data were collected from five repeated tests. A resting time of 3 min was given between each test to prevent muscle fatigue. Stepwise multiple regression analysis was used to determine the optimal and maximal loads during the hip adduction exercise. A stepwise multiple regression analysis was performed using gender, body weight and height variables to identify the most informative variables for predicting the optimal and maximal loads during the hip adduction exercise. The coefficients for the regression analysis and the regression model for the optimal and maximal loads during the hip adduction exercise were determined. Significance was accepted for values of \(< 0.05\).

**RESULTS**

To control for the gender, body weight, and height variables, stepwise multiple regression was performed for the optimal and maximal hip adduction loads. The regression model for optimal hip adduction load (kg) was: \(34.3 + 0.4 \times \text{weight} - 0.27 \times \text{height} (r^2=0.77, p<0.05)\); and the regression model for maximal hip adduction load (kg) was: \(39.5 + 0.5 \times \text{weight} - 0.3 \times \text{height} (r^2=0.75, p<0.05)\).

**DISCUSSION**

This study measured the optimal and maximal loads during hip adduction exercise in asymptomatic subjects. The most informative variables for predicting the optimal and maximal loads during the hip adduction exercise were determined on the basis of statistical regression. The results show that weight and height were the most informative variables for both optimal and maximal hip adduction loads. Using information from these models can aid in deciding the optimal and maximal hip adduction loads for clinical and fitness purposes, respectively. The selection of the exercise load is a very important factor for effective exercise. A previous study investigated the influence of a resistive band on the muscles with leg adduction performance in a variety of positions\(^5\). That study showed that hip adduction with a resistive device increased trunk stability\(^6\). The general goal of hip adduction training is core stability. Core stability of the trunk can be viewed as a box, with, the diaphragm as the roof and the pelvic floor and hip muscles as the bottom\(^7\). The abdominals comprise the anterior part of the box and the paraspinals and gluteals the posterior part\(^8\). This co-activation of the hip adductor, pelvic floor, and internal abdominal muscles is necessary for the occurrence of intra-abdominal pressure\(^9\). It also reinforces the strength of the multifidus and aids spinal stability\(^9\). Thus, the optimal hip adduction load model can be used to strengthen the hip adductor muscles or enhance core stability in the clinical setting. Although the independent variables of this study used simple general characteristics, the regression coefficients of R-squared over 0.7 indicate highly reliability in predicting the dependent variables. The variables selected by regression analysis in this study were weight and height, which have the advantage of being measured easily in the clinic by physical therapists. Therefore, our study results can help with the selection of the ideal hip adduction loads in clinical situations. This study had several limitations. Maintaining maximum loading requires significant effort and is difficult to sustain. This study evaluated asymptomatic subjects to obtain a standard value. Therefore, the models derived cannot be used for patients with pain.

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**REFERENCES**