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CONTEXT

Contralateral strength training, commonly known as cross education, is defined as a neurophysiological phenomenon where an increase in strength is witnessed within an untrained limb following training on the opposite, paired limb. *"This so called 'contralateral strength training effect' or 'cross education' is task specific and occurs in the opposite, homologous muscle."*[1(pg1)] In tandem to this, there has been little-to-no difference in strength gained being dependent on gender. In fact, according to previous studies there is similar variability in men and women for relative size gains and mode-dependent gender differences or relative strength gains.[2]

OBJECTIVE

To investigate the presence of contralateral strength gains through the theory of cross education when performing an exercise on the opposite side of the body in pre-professional athletic training students.

DESIGN AND SETTING

Quantitative research study with a focus in interval and nominal data with descriptive statistics such as mean (average) of each grip strength measurement along with the average of the measurement totals, and the standard deviation of the average grip strengths of non-dominant and dominant hand grip strengths of both control and treatment groups. Inferential statistics were utilized through independent t-tests ran on data collected from treatment and control groups on both dominant and non-dominant hands. Students were surveyed and chosen at random for participation from a pool of consenting individuals meeting study criteria. Demographic questions established the individuals' gender, dominant hand, sport participation, and participation in an individualized strength gains program. Measurements of degree of muscle strength through average grip strength measurements were recorded via dynamometer pre- and post-exercise program per individual. Independent variable was the population of consenting athletic training students at a small, Midwestern, Division III, private, liberal arts institution. Dependent variable was a predetermined grip strengthening program. Setting was a small, Midwestern, Division III, private, liberal arts institution.

PARTICIPANTS

Convenience sample used to choose participants; sample size of thirty individuals was chosen (N = 30) with a return rate of 83% (n=25), control group of thirteen individuals (n = 13), and test group of twelve individuals (n = 12). In the test group seven participants were female (53%) and five were male (42%). In the control group ten participants were female (77%) and three were male (23%). All twenty-five participants were right hand dominant (100%).

INTERVENTION

Following acceptance into the study participants completed a two-week long grip strengthening program utilizing Thera Putty® of progressive resistances. Post-treatment grip strength measurements were taken at the end of two-weeks and compared to pre-treatment values. Values of both groups pre- and post- study measurements were compared for statistical significance using Statistical Package for the Social Sciences (SPSS) 24.0. Face validity was established by expedited review through a panel of experts. Independent and paired t-tests were run through SPSS 24.0 to assess statistical significance of values with an alpha level of p = 0.05 a priori.

MAIN OUTCOME MEASURES

Independent t-tests were used to assess statistical significance of pre- and post-test grip strength averages of the control and test groups. The study investigated the comparison between the average grip strength of the dominant and non-dominant hand after a two-week grip strengthening program utilizing Thera Putty performed on the dominant hand to investigate the presence of any contralateral gains/cross-education within the body.

RESULTS

Statistical analysis showed there was a statistically significant change in non-dominant hand grip strength of both control and treatment group after intervention. Statistical significance for the control group values can be attributed to background knowledge of the tool (i.e. the hand held dynamometer) due to all participants being athletic training students at the institution with prior knowledge of the device and the study as a whole. The 12 individuals whom were a part of the treatment group experienced +8.92 pounds of force increase within the non-dominant hand as strength at baseline was averaged at 49.83 pounds of force and increased to 58.75 pounds of force averaged at the end of the treatment period. The treatment group's dominant hand strength increased by an average of +1.72 pounds of force. At baseline the dominant hand strength averaged to 57.00 pounds of force and increased to 58.72 pounds of force post-treatment. Control group non-dominant hand grip strength was averaged at baseline measurements to equate 41.18 pounds of force and increased to 43.53 pounds of force for a total average increase of +2.35 pounds of force at the end of the evaluation period. The control group consisted of 13 individuals for which dominant hand grip strength at baseline was averaged to equate 49.00 pounds of force and decreased to 44.69 pounds of force for a strength loss of -4.31 pounds of force. There was unknown cause for this decrease. Treatment: $t= 2.673$, $df = 48$, $p = 0.010$; Control: $t = 2.673$, $df = 43.472$, $p = 0.011$, with a mean increase of non-dominant treatment group grip strength equating + 8.92 pounds of force and a control group non-dominant grip strength equating +2.35 pounds of force**.**

CONCLUSIONS

It is likely that the non-dominant grip strength increase was directly caused by contralateral gains resulting from a strengthening program performed by the dominant hand. The increase of non-dominant hand strength supports the study's hypothesis that the presence of cross education can be effective. The results of this study indicate that cross education was effective at increasing grip strength on the contralateral hand. These results are promising and could be applied in other body parts where strength gains are

limited due to surgical intervention, injury, or other underlying pathologies.

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***KEY WORDS**: Contralateral training, dominant/non-dominant hand, grip strength, Thera Putty®*