The Effects of High-Intensity Training On The Cybex Arc Trainer on Functional Capacity in Moderately Fit Adult Men.

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Introduction

Many aerobic training devices have been assessed for their ability to promote metabolic improvements, such as oxygen consumed or calories expended. Such devices have also been evaluated along subjective lines, such as measuring perceived exertion, or even discomfort. And of course, the effects of cardiovascular training on weight loss or serum cholesterol have been popular subjects of research.

Little, on the other hand, has been done to assess the ability of a cardio machine to produce functional outcomes in its users. The obvious explanation is that cardio machines are only useful for cardiovascular conditioning. Recently, however, Graves and Juris have reported on the biomechanical properties of the Cybex Arc Trainer, indicating that the forces generated during use of the machine create effective loading around the hips and knees. If effective levels of resistance and movement velocity could be achieved on such a device, then it is possible that a functional outcome could be produced.

The purpose of this study, therefore, is to determine whether high intensity training on the Cybex Arc Trainer can improve the functional capacity of moderately fit males, as measured on an established test of leg function.

Subjects and Methods

Ten healthy males from a return to exercise program were randomly placed into an Arc training group. Ten age- and fitness-matched males were then assigned to a control group. Mean age and height for the Arc group was 39.7 ± 5.9 years and 178.4 ± 5.2 cm, while the control group's age and height were 37.8 ± 6.2 years and 177.1 ± 5.1 cm, respectively. None of the subjects had a history of back, knee, hip or ankle injury.

Testing

Functional leg capacity was determined by administering the hop and stop test, as described by Juris, et al. The hop and stop is comprised of three key measures. Maximum hop for distance (taking off on one leg and landing on the same) indicates a subject's ability to produce force. Maximum hop as a percentage of height (Hop % HT) compares a subject's maximum hop to established norms of hopping capacity. Maximum controlled leap (taking off from

one leg and landing on the opposite) measures the maximum distance at which the subject can execute a controlled landing, thus assessing force absorption.

The hop and stop test was administered on a turf surface with a tape measure to assess the distance of each attempt (pictured).

For the maximum hop test, subjects were encouraged to achieve maximum horizontal distance without concern for their landing. For the leaping component, the primary requirement was to "stick" the landing so that subjects could not shift or pivot the landing foot or place the opposite foot down for support. Additionally, they had to arrive at a complete stop with their hands on their hips within one second.

Three hops and leaps were attempted on each leg. Mean values were computed for each limb, and then the means were combined to create an overall hopping and leaping score.

Arc Training Protocol

After practicing on the Arc trainer, the Arc group exercised three days per week for three weeks. The initial session was an interval protocol designed to establish exercise workloads. The protocol consisted of four minutes of work at an arbitrary workload, and a pace of 120 strides per minute (SPM), followed by a one minute rest interval. This was repeated four times, for a total of nineteen minutes.

If the subject could keep pace at the established workload for the entire four-minute interval, resistance was increased. If at any time SPM dropped below 120, resistance was lowered to a level at which the subject could maintain the prescribed pace.

The second session involved twenty-second sprint intervals, using the maximum resistance from the four-minute protocol as a starting workload. Subjects were

given three minutes to adjust to the settings and attempted several five- to ten-second practice “sprints,” gradually increasing their cadence to 170 SPM.

After a two-minute rest period, the subject performed a ten-second build-up to 170 SPM, and then attempted to hold that pace for another twenty seconds. If cadence was sustained for the required twenty seconds, the workload was increased for the next interval. If at any point, the subject could not maintain the pace over the twenty seconds, the load was decreased. Each work interval was followed by ninety seconds of active recovery at a pace of less than 50 SPM.

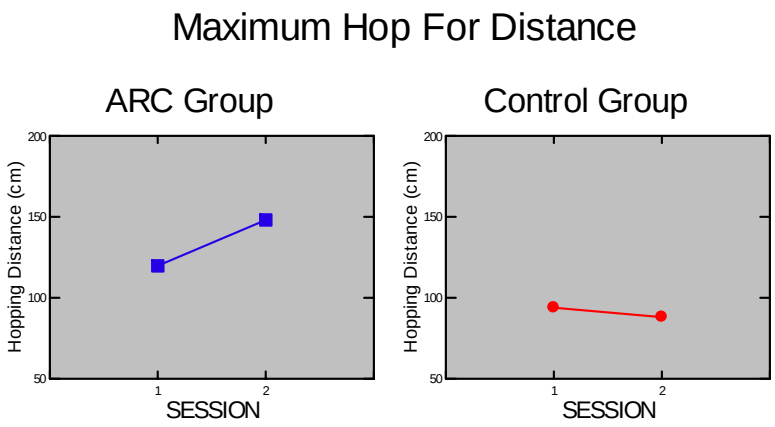
The two workouts were alternated, with 48 hours of rest between them, for the three week period. The post test was administered within one week after the final training session.

Control group subjects did not exercise during the three-week training period.

Results

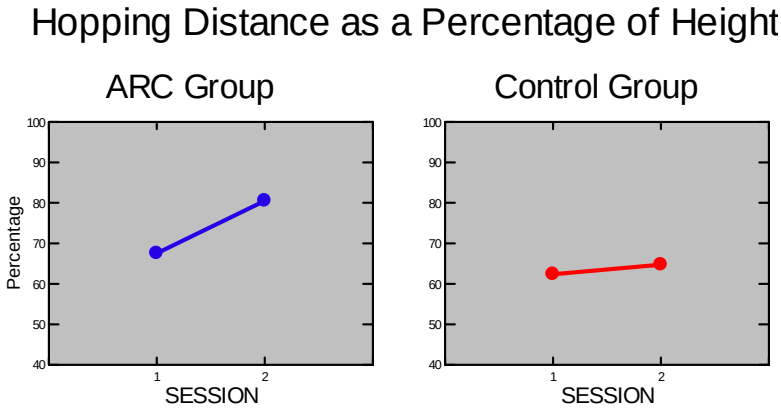
The pre test maximum hop for distance was 121.4 ± 16.0 cm for the control group and 129.8 ± 19.5 cm for the Arc group. The difference of 8.4 ± 3.5 cm was not significant, indicating that the groups were the same before training.

After three weeks of training, mean maximum hop for distance improved significantly ($p < .05$) in the Arc group by nearly 20 cm, to 149.2 ± 13.0 cm. Post test mean maximum hopping distance for the control group, 120.9 ± 16.3 cm, was not significantly different from the pre test value, indicating no improvement for this group. In contrasting the two group’s post test scores, the control group’s hopping distance was significantly lower ($p < .05$) than the Arc group’s value, indicating a significant improvement in maximum hopping distance as a result of the Arc Trainer protocol.



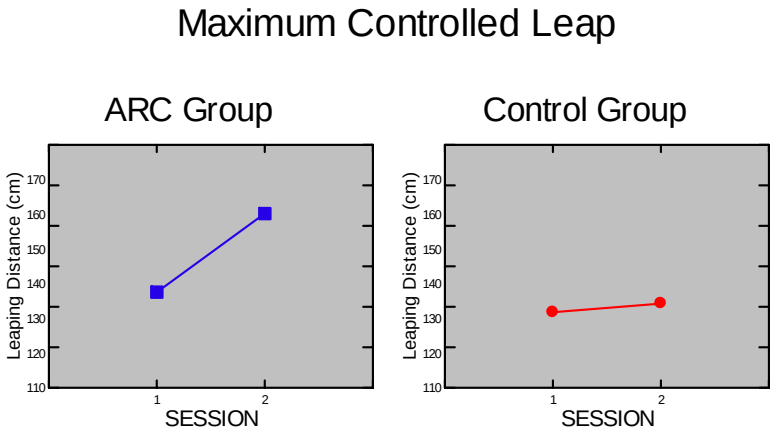
Pre test scores for Hop % Height were 68.6 ± 9.3 and 72.9 ± 12.1 for the control and Arc groups, respectively. These differences were not significant. Post test

values, on the other hand, were 68.3 ± 9.3 for the control group, and 83.7 ± 8.4 for the Arc group. While the control group demonstrated no change in performance between pre and post tests, the Arc group improved significantly from test to test ($p < .05$), and demonstrated a 15.4% greater performance than the control group ($p < .05$), indicating substantive improvements as a result of the Arc training protocol.



Pre test mean values for maximum controlled leap were 136.4 ± 13.3 cm for the control group and 143.6 ± 9.5 cm for the Arc group. These scores were not significantly different.

The post training mean maximum controlled leap for the Arc group improved to 163.0 ± 8.4 cm. This value was significantly greater than the pre test value ($p < .05$). The control group's mean maximum controlled leap was 138.4 ± 13.5 cm for the post test. This score was not significantly different from the group's pre test value. The difference in post test leaping distance between the Arc and control groups, however, was significant ($p < .05$), indicating improved force absorption as a result of the Arc trainer protocol.



Discussion

The results of this study indicate that the Cybex Arc Trainer, used at a sufficiently high intensity, can improve the dynamic functional capacity of the legs. Subjects engaging in just three weeks of Arc training demonstrated significant improvements in power, both in force production and absorption.

It is also worth noting the Hop % Height scores registered in this study. Juris and colleagues reported that men should achieve a maximum hop value of 80% of their height in order to meet the minimum standard of performance. As revealed here, the mean scores for both groups fell below this threshold at the initial test. Subsequently, however, the Arc Trainer group not only improved its score significantly over the control group, but it also pushed its mean value above the 80% minimum criterion. Thus, Arc training helped to improve dynamic functional capacity in moderately fit men.

References

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Juris, P.M., Phillips, E.M., Dalpe, C., Edwards, C., Gotlin, R.S., Kane, D.J. (1997). A dynamic test of lower extremity function following anterior cruciate ligament reconstruction and rehabilitation. Journal of Orthopaedic and Sports Physical Therapy. 26(4): 184-191.