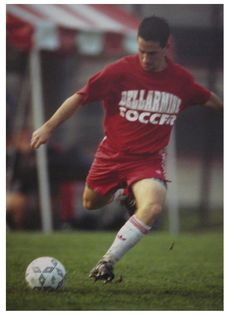
IMPROVED LOWER EXTREMITY NEUROMUSCULAR ACTIVATION AND GROUND REACTION FORCE TIMING AFTER PROGRESSIVE RESISTANCE, WHOLE BODY, LONG-AXIS ROTATIONAL TRAINING

Nyland J, Burden R, Krupp R, Caborn DNM

Department of Orthopaedic Surgery , University of Louisville, USA

Introduction

Optimized neuromuscular activation and ground reaction force timing may improve athletic performance and decrease injury risk.[1,2]

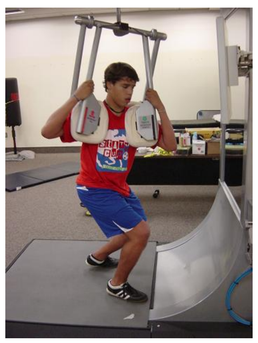


Purpose

To evaluate the efficacy of progressive resistance, whole body, long-axis rotational exercise training for improving lower extremity neuromuscular activation and ground reaction force timing.

Participants

36 healthy, recreational athletes (age = 24.1 ± 5 yrs, height = 175.7 ± 10 cm, weight = 72.9 ± 11 kg) were randomly assigned to groups with an equal number of men and women.



Median 2000 IKDC Self-Reported Activity Level was 3 (well-trained and frequently sporting) for both groups. Range = level 2 (sporting sometimes) to level 4 (highly competitive).

Methods

Over 4 weeks, Group 1 performed 9, 20 min training sessions consisting of 7 sets on a Ground Force 360 Device (Center of Rotational Exercise, Clearwater, FL, USA). The control group (Group 2) did not use the test device.

Groups continued regular athletic activities (soccer, basketball, tennis, swimming, volleyball, running) without increasing intensity or volume.

Surface EMG electrodes were applied over the gluteus maximus (GMX), gluteus medius (GME), vastus medialis (VM), rectus femoris (RF), vastus lateralis (VL), medial hamstrings (MH), biceps femoris (BF) and gastrocnemius (G) of the left (preferred stance) lower extremity.

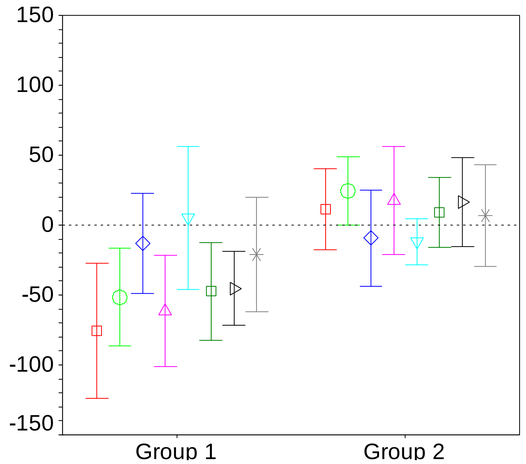
A retro-reflective marker placed over an athletic shoe marked the left foot fifth metatarsal head.

Independent sample t-tests with Bonferroni adjustments were used to compare group mean change differences (MCD)($P \leq 0.0045$).

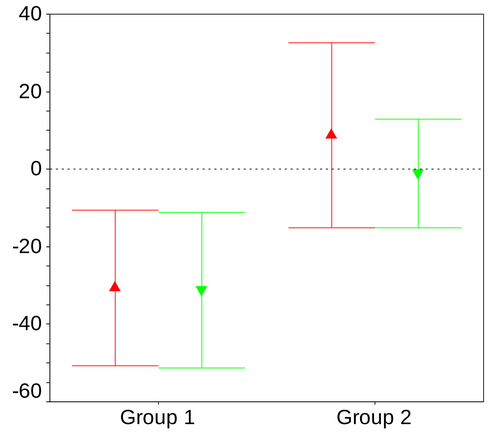
Time-synchronized EMG (1000 Hz), two-dimensional sagittal plane kinematic (60 Hz), and peak resultant ground reaction force (GRF) (1000 Hz) data were collected as subjects, responded to a random audio cue by moving as quickly as possible from an athletic ready position to kick a traffic cone placed 40 cm in front of the force plate with their left foot.

Results

Groups did not differ for cue timing (Group 1 = 14844 ± 3916 msec; Group 2 = 14704 ± 2261 msec, P = 0.92). Group 1 displayed earlier GMX (P = 0.004)(□), GME (P = 0.001)(○), RF (P = 0.003)(△), MH (P = 0.004)(□), and BF (P = 0.002)(▷) neuromuscular activation MCD compared to Group 2. Significant differences were not observed for VM (◇), VL (▽), or G (✳).



Group 1 MCD had improved kick quickness (-30.6 ± 39 msec vs. 8.8 ± 44.7 msec, P = 0.004)(▲) and earlier peak GRF timing (-31.2 ± 39.1 msec vs. -1.1 ± 26 msec, P = 0.004)(▼) compared to Group 2. Peak GRF magnitude MCD did not differ between groups.



Discussion & Conclusions

Earlier neuromuscular activation timing (gluteus maximus, gluteus medius, rectus femoris, medial hamstring, and biceps femoris), improved kick quickness, and earlier peak GRF timing was only observed in the training group. Findings suggest that device training may improve sports performance and decrease injury risk.

Recommendations

Further study is indicated to determine the efficacy of Ground Force 360 device use for decreasing the incidence of non-contact lower extremity injuries among high risk athletic populations.

References

1. Nyland J, et al. Single leg jumping neuromuscular control is improved following whole body, long-axis rotational training. J Electromyogr Kinesiol. 2010; 21:348-55.

2. Nyland J, et al. Whole body, long-axis rotational training improves lower extremity neuromuscular control during single leg drop landing and stabilization. Clin Biomech. 2010;26:363-70.

Acknowledgements

Institutional Review Boards of the University of Louisville and Norton Healthcare approved this study. Funding was provided by the Fischer-Owen Fund for Orthopaedic Research. Presented at World Physical Therapy 2011, Amsterdam June 2011'

Contact details

J. Nyland DPT, SCS, EdD, ATC, CSCS, FACSM

John.nyland@louisville.edu