# EFFECTS OF UNILATERAL STRENGTH TRAINING ON CONTRALATERAL ONE - LEGGED STANDING BALANCE

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**Introduction** Strength training of ipsilateral limb leads to the changes in the contralateral limb [2, 3, 6, 8, 9, 10, 12, 18] This phenomenon is called cross education. It has been known for 118 years. Today this phenomenon is well-known in the field of motor control and it is one of the most important indicators that the changes in strength and power, caused by unilateral strength training, is result of neural adaptations [11]. Studies have shown a positive correlation between strength of lower extremity and balance among older [7, 14] and younger person [17]. It is known that hip isokinetic exercise of the dominant leg leads to the improvement in contralateral balance performance [9]. It is not known how unilateral concentric contractions of knee extensors and flexors, and ankle dorsi and plantar flexors on isokinetic dynamometer influence on contralateral balance performance.

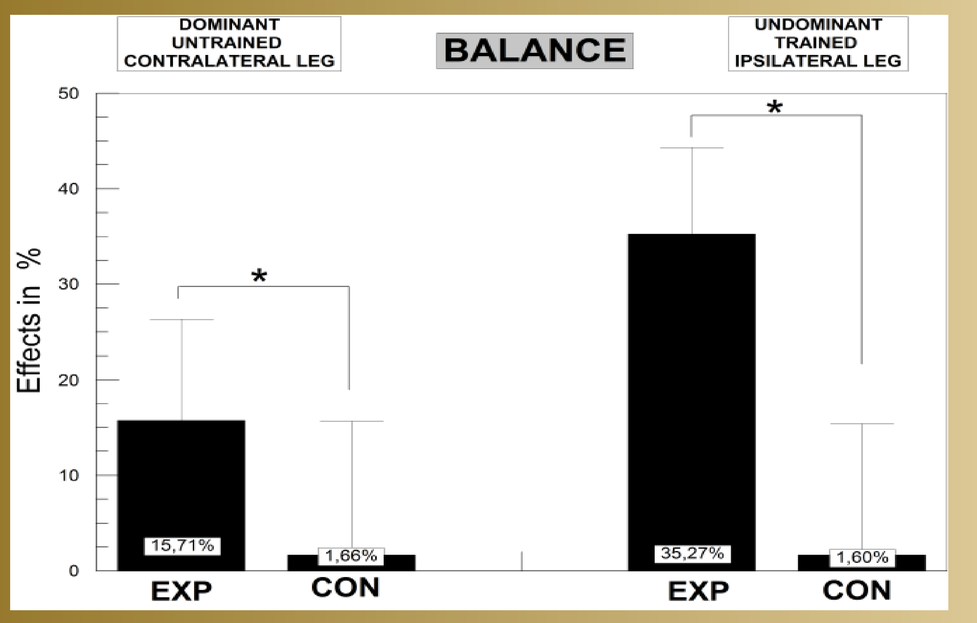
**Methods Subjects.** 30 young, healthy, and physically active women were randomly allocated to one of two groups: 1) control group (n=15), 2) experimental group (n=15).
**Training program.** The unilateral isokinetic con-con training program of knee extensors and flexors (60°/s) and ankle dorsi and plantar flexors (30°/s) consisted of three training per week for four week. It was performed on Biodex isokinetic dynamometer.
**Testing procedure.** Each participant was tested Pre and Post 4-week training period. Testing procedure included one-legged standing balance measurement, followed by leg strength measurement.
**One - legged standing balance**. Single-limb postural stability was assessed on a Biodex Stability System, level 5. Measures of dynamic balance included overall stability index scores (OSI).
**Data analyses.** Pre and Post training Means and SDs were calculated for ipsilateral (trained) and contralateral (untrained) one – legged standing balance in both group. *t*-test for independent (EXP – CON) and dependent (Pre-Post) samples was set at $p < 0,01$.

**Results** The results of t-test for independent samples showed that there is no statistically significant difference in BALANCE test of dominant and undominant leg between groups in Pre testing. For this reason, statistically significant changes in the ipsilateral and contralateral single leg balance between Pre and Post testing (Table 1.) attributed to the effects of training program.

| BALANCE | EXP (Pre) | EXP (Post) | CON (Pre) | CON (Post) |
|---|---|---|---|---|
| IPSILATERAL | 2,07 (0,82) | 1,34* (0,57) | 2,34 (0,77) | 2,27 (0,86) |
| CONTRALATERAL | 1,91 (0,58) | 1,61* (0,50) | 2,41 (0,62) | 2,37 (0,65) |

**Table 1.** Pre and Post training descriptive data (Means ± SD) for the balance test of the ipsilateral (trained) and contralateral (untrained) leg in the experimental and control group. *t*-test for dependent samples was set at $p < 0,01$.

**Fig.1.** The percent of changes in BALANCE test OSI in EXP and CON group in contralateral (untrained) and ipsilateral (trained) leg. *t-test* for independent samples was set at p<0,01.




**Discussion and Conclusion** The results of this study show that unilateral con-con strength training of lower extremities improve balance of ipsilateral leg for 35 %, and contralateral for more than 15 %. The results of this study are in accordance with the study from 2011. [9] in which hip was unilateraly trained. In our research were trained muscles that surround the joints relevant for one-legged standing balance. Obtained results significantly extend our perception about cross education phenomenon. Contralateral training effects are relevant and these results could provide the implementation potential in many areas, especially in the field of physical medicine, rehabilitation, prevention of falls and injuries.

**References**

1. Arnold et al., J. Athl. Train. 33, E323-327, 1998.
2. Brent et al., *Am. J. Phys. Med.* 65, E135-143, 1985.
3. Brent et al., *S. M. J.* 81, E989-991, 1988.
4. Carroll et al., *J. Appl. Physiol.* 101, E1514-1522, 2006.
5. Gage et al., Gait. Posture.*19*, E124-132, 2004.
6. Hellebrandt et al., Arch. Phys. Med. Rehabil. 28, E76-85, 1947.
7. Horlings et al., Nat. Clin. Pract. Neurol. 4, E504-515, 2008.
8. Hortobágyi, IEEE. ENG. MED. BIOL. *24*, E22-28, 2005.
9. Kim et al., Gait. Posture. 34, E103-106, 2011.
10. Lee et al., J. Physiol. 588, E201-212, 2010.
11. Lee et al., Sports. Med. 37, E1-14, 2007.
12. Munn et al., J. Appl. Physiol. 96, E1861-1866, 2004.
13. Paterno et al., J. Orthop. Sports. Phys. Ther. 34, E305-316, 2004.
14. Pijnappels et al., J. Electromyogr. Kinesiol. 18, E188-196, 2008.
15. Rein et al., Clin. Neurophysiol. 122, E1602-1610, 2011.
16. Rein et al., Arch. Orthop. Trauma. Surg. 131, E1043-1052, 2011.
17. Thorpe et al., J. Strength. Cond. Res. 22, E1429-1433, 2008.
18. Zhou, Exerc. Sport. Sci. Rev. 28, E177-184, 2000.