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UNDERSTAND THE ACTIVE STRAIGHT LEG RAISE (ASLR): AN ELECTROMYOGRAPHIC STUDY IN HEALTHY SUBJECT

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SUMMARY
During the Active Straight Leg Raise (ASLR), the abdominal muscles showed bilateral activity, but there was significant side effect in TA and OI, not in OE and RA. Actually, the abdominal muscles were differently involved in different tasks, some tasks being intrinsically symmetrical, some unilateral only. During ASLR, the forward pulling of the pelvis by hip flexors needs to be countered by contralateral hip extension and/or activity of the abdominal muscles; symmetrical force closure must ensure that the pelvis moves as one unit in the sagittal plane, and a balance is needed between ipsi- and contralateral rotation of the pelvis. Therefore, to better understand ASLR, future research should include the 3 dimensional kinematics and kinetics of the pelvis and trunk.

INTRODUCTION
Women with Pelvic girdle Pain (PGP) may have trouble with the Active Straight Leg Raise (ASLR) [1]. The abdominal muscles showed bilateral activity in literature [2]. The mechanism of these abdominal muscles perform in laterality is still unclear.

METHODS
We assessed muscle activity of 16 healthy nulligravidae during ASLR with 3 conditions. Fine-wire Electromyography (EMG) was used to record activity of the transversus abdominis (TA), while other abdominal and hip muscles were recorded with surface EMG.

The ASLR was performed in supine position with the feet 20 cm apart. Subjects were instructed to raise one leg until the heel was 20 cm above the table, without bending the knees, and keeping the leg elevated for about 10 s ("Normal"). This was done three times per leg per condition. After every ASLR, subjects were asked to relax for approximately 10 s. The whole procedure was repeated with a weight added just above the ankle ("Weight") and with a non-elastic pelvic belt just below the ASIS("Belt").

RESULTS AND DISCUSSION
During ASLR, all abdominal muscles were bilaterally active, whereas activity of the leg muscles was clearly ipsilateral in rectus femoris and contralateral in biceps femoris. With Weight, there are more activity except TA (where the interaction was significant), and less activity with the belt in all muscles. Side effect is significant in TA and OI, but not in OE and RA. For former two muscles, the median Asymmetry Index is comparatively high in OI, even higher in TA. Inter-individual variabity is large.

Actually, the abdominal muscles were differently involved in different tasks, some tasks being intrinsically symmetrical, some unilateral only. During ASLR, the forward pulling of the pelvis by hip flexors needs to be countered by contralateral hip extension and/or activity of the abdominal muscles; symmetrical force closure must ensure that the pelvis moves as one unit in the sagittal plane, and a balance is needed between ipsi- and contralateral rotation of the pelvis [3,4].

Thus, "symmetry" is a property of certain tasks and not an empirical property.

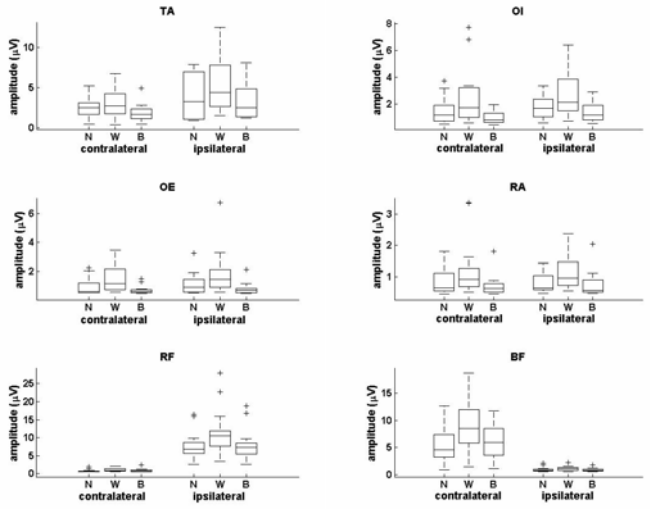

Figure 1: Box plots of median muscle activity (mV) during ipsilateral and contralateral ALSR in three conditions (N: Normal,W: withWeight added, B: with a pelvic Belt). Each box runs from the 25 to the 75 percentile; the transverse line inside the box indicates the median, "+" represents outliers, and the error bars represent the range, excluding the outliers.Note the scale differences. TA: m. transversus abdominis, OI: m. obliquus internus abdominis, OE: m. obliquus externus abdominis, RA: m. rectus abdominis, RF: m. rectus femoris, BF: m. biceps femoris.

CONCLUSIONS

To better understand ASLR, future research should include the 3 dimensional kinematics and kinetics of the pelvis and trunk.

REFERENCES

1. Mens JM, Vleeming A, Snijders CJ, Stam HJ, Ginai AZ. The active leg raising test and mobility of the pelvic joints. *European Spine Journal* **8(6)**:468-73, 1999;
2. Hu H, Meijer OG, Van Dieen JH, Hodges PW, Bruijn SM, Strijers RL, et al. Muscle activity during the active straight leg raise (ASLR), and the effects of a pelvic belt on the ASLR and on treadmill walking. *Journal of Biomechanics* **43(3)**:532-9, 2010;
3. Liebenson C, Karpowicz AM, Brown SH, Howarth SJ, McGill SM. The active straight leg raise test and lumbar spine stability. *Physical Medicine and Rehabilitation* **1(6)**:530-5, 2009;
4. Urquhart DM, Hodges PW. Differential activity of regions of transversus abdominis during trunk rotation. *European Spine Journal* **14(4)**:393-400, 2005.