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Changes in the intermuscular coherence of the multifidus and its relationship with fatigue and low back pain: a pilot study.

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INTRODUCTION & AIM

The relationship between trunk muscles, low back pain, and exercise has been studied for many years. Subjects with low back pain have shown different responses to fatigue compared to healthy subjects, and this particular behaviour has been proposed as a predictor of low back pain. Several experimental studies have been conducted to identify valid and reliable biomarkers that explain the functioning of the trunk muscle complex [1-4]. The aim of this study was to analyse the behaviour of the lumbar musculature in healthy subjects and a subject with a history of low back pain.

METHOD

Five adult male participants in the age range of 21 to 28 years, with at least 2 years of strength training experience, volunteered to participate in the present study. Four participants reported no history of low back pain in the past 3 months of training. One participant reported nonspecific low back pain in the past three months of training prior to the study.

Three sets of the squat exercise were performed with progressive overload from 40 to 60% of body weight.

Each participant was instructed to hold a tempo for the movement, consisting of 3 seconds for the downward phase, 1 second in the transition phase, and again 3 seconds for the upward phase (Fig. 1 and 2)

Fig. 1. Experimental setup.

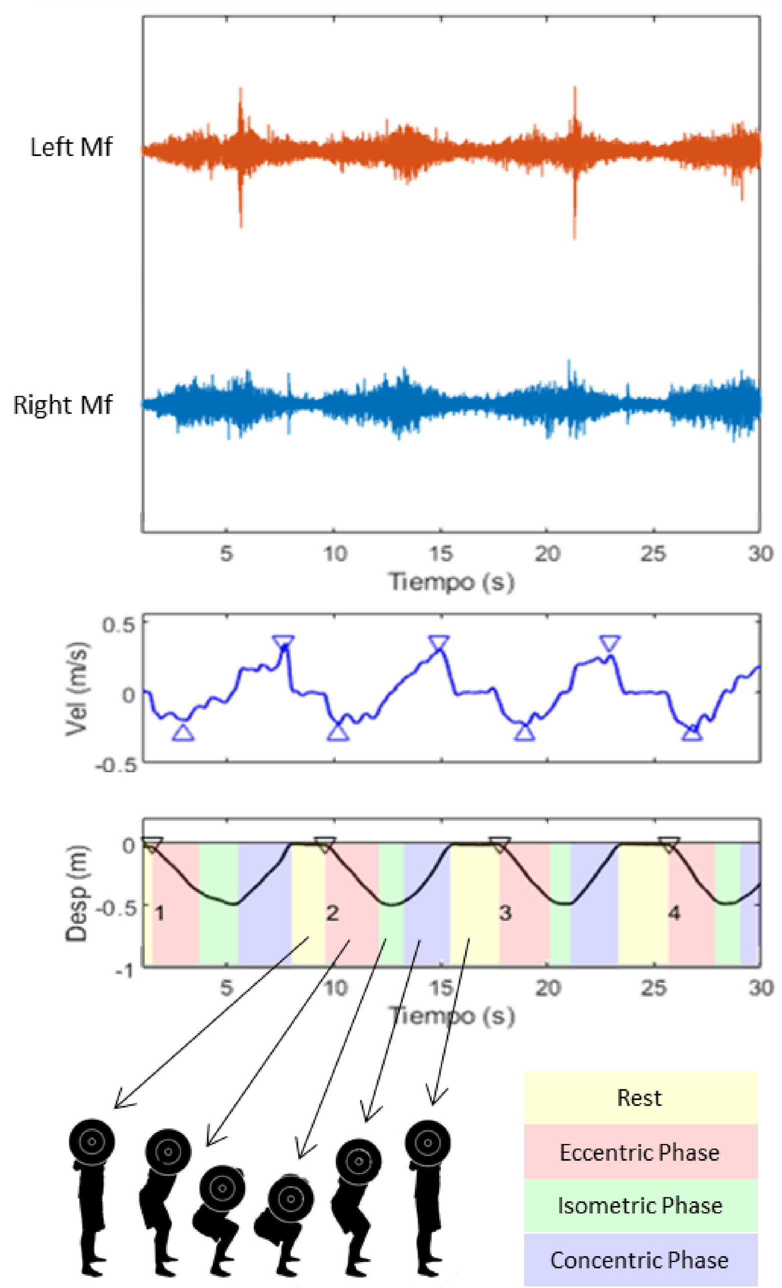

Fig. 2. Example of synchronized recordings. In the upper panel, peak velocity detection (▽ in blue). In the lower panel, the division of movement phases (four colors).

In last serie they performed as many repetitions as possible at controlled eccentric and maximal concentric speeds.

To establish the functional connectivity index between the Multifidus muscle pair, the intermuscular coherence (IMC) was computed through a procedure that allows calculating the coherence between two time-frequency maps [5]. A statistical test is then applied to determine the sectors where the coherence is significant. Finally, one or more windows of interest are selected. In this work, the IMC was calculated only during the concentric phase of the proposed exercise. The window of interest was established in the beta band (from 15 to 30 Hz) and with a time window of 500 ms centered on the peak velocity (±250 ms). (Fig. 3 and 4)

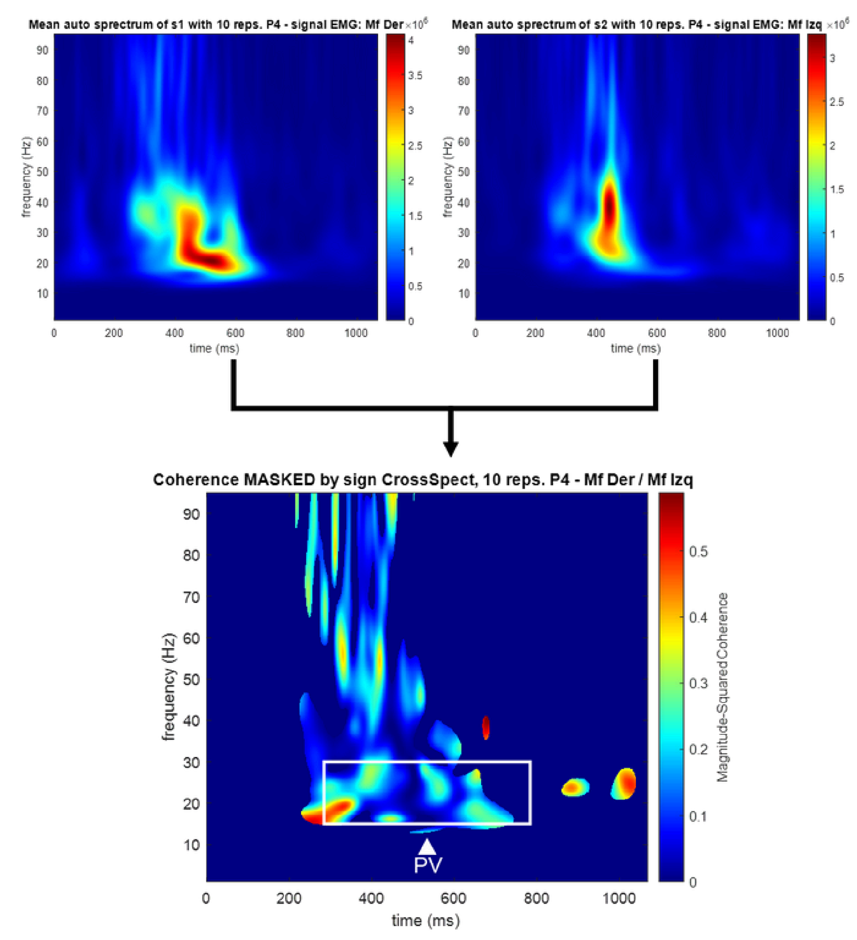

Fig. 3. Example of the IMC computation procedure. In the lower panel, the coherence between the upper maps. The window of interest (white rectangle) is indicated, centered according to the peak velocity (PV) of execution.

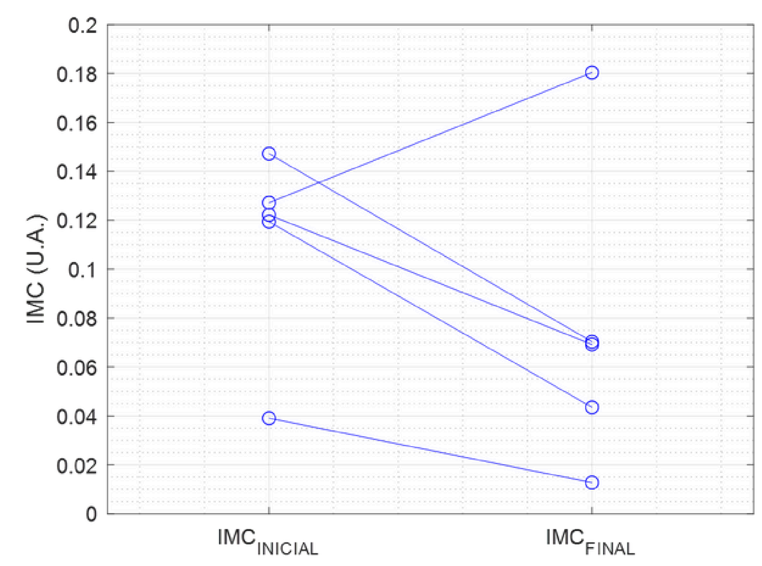

Fig. 4. Trends in connectivity changes

RESULTS & DISCUSSION

The findings indicated that intermuscular coherence (IMC) decreased among control subjects by the end of the squat series, whereas the subject with a history of low back pain exhibited the opposite trend. These results contrast with the existing literature, though the study's limitations preclude definitive comparisons.

CONCLUSION

Despite the findings, IMC could potentially be a valuable tool for characterising fatigue and low back pain.

REFERENCES

[1] S. C. Gandevia, «Spinal and Supraspinal Factors in Human Muscle Fatigue», Physiol. Rev., vol. 81, n.o 4, pp. 1725-1789, ene. 2001, doi: 10.1152/physrev.2001.81.4.1725.

[2] S. Ghazi, M. R. Hadian, A. Shadmehr, S. Talebian, G. Olyaei, y E. Hajouj, «Test-retest Reliability of EMG β-Band Intermuscular Coherence of Non-specific Chronic Low Back Pain During Flexion-extension Task», J. Mod. Rehabil., nov. 2021, doi: 10.18502/jmr.v15i2.7727.

[3] P. C. R. Dos Santos, C. J. C. Lamoth, F. A. Barbieri, I. Zijdewind, L. T. B. Gobbi, y T. Hortobágyi, «Age-specific modulation of intermuscular beta coherence during gait before and after experimentally induced fatigue», Sci. Rep., vol. 10, n.o 1, p. 15854, sep. 2020, doi: 10.1038/s41598-020-72839-1.

[4] C. Charissou, L. Vigouroux, E. Berton, y D. Amarantini, «Fatigue- and training-related changes in 'beta' intermuscular interactions between agonist muscles», J. Electromyogr. Kinesiol., vol. 27, pp. 52-59, abr. 2016, doi: 10.1016/j.jelekin.2016.02.002.

[5] J. Bigot, M. Longcamp, F. Dal Maso, y D. Amarantini, «A new statistical test based on the wavelet cross-spectrum to detect time– frequency dependence between non-stationary signals: Application to the analysis of cortico-muscular interactions», NeuroImage, vol. 55, n.o 4, pp. 1504-1518, abr. 2011, doi: 10.1016/j.neuroimage.2011.01.033.