Reviewer's comments concerning “Altered breathing patterns during lumbopelvic motor control tests in chronic low back pain: a case–control study” (J. Nijs et al., ESJO-D-08-00264 R2)

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This study intends to explore the influence of low-back pain on breathing patterns at rest and during performance of clinical tests assessing the motor control function in a group of LBP patients and of healthy individuals. According to their observations, the authors conclude that altered breathing patterns are exhibited in a substantial proportion of patients when compared with healthy subjects. The study sample is rather small ($n = 20$) but relevant to a pertinent statistical analysis of the results.

The breathing patterns were evaluated as normal or abnormal using visual inspection and palpation of the thoraco-abdominal motion of the subjects at rest, and only with visual inspection during the motor tests. This methodology intended to assess activity of the diaphragm and abdominal muscles is rather subjective, especially in absence of inter and intra-observer reliability testing. One can only agree with the authors that scientific validation of the results by electromyography is required. A similar observation regarding the scientific reliability of the results obtained by the pressure biofeedback unit (PBU) is equally pertinent. It should be recognized, however, that in order to reinforce the validity of the results, the authors provide the reader with a summary of available studies of diaphragmatic and abdominal muscle activities where the pressure rates estimated by the PBU were confirmed in one of them by electromyography. Notwithstanding the critical importance of these methodological considerations and assuming the robustness of the results, a few points merit further discussion.

One comment concerns the etiology of the altered respiration in LBP patients. Changes of breathing patterns were observed in over half of the patients during deep breathing in standing position and in quiet breathing during the two motor tests: ASLR and BKFO, well depicted in figures 2 and 3. These tests analyze the motor control of the lumbar-pelvic region. Studies including two references (11 and 12) mentioned by the authors suggest that respiration per se perturbs the postural control strategy and apparently more so in patients with LBP. In the authors' view, altered breathing takes place while standing in patients “who favor the postural function of the diaphragm and of the transversus abdominis thereby disadvantaging the respiration”. The question is: what is the cause of the postural instability and why do patients react during the motor tests with altered breathing and a possible recruitment of the diaphragm and abdominal muscles to improve lumbo-pelvic stability? Regulation of the proprioceptive postural control is a very complex phenomenon, principally expressed at the level of the lower limbs and of the trunk under the control of the CNS. In standing position the motion segments are subjected to a forward-bending moment which must be counterbalanced by erector spinae muscles and ligaments. Contraction of these structures may stimulate the nociceptors of the muscles which in turn elicit spinal reflexes increasing the muscle contraction and the pain state. In addition, various segmental and supra-spinal (brain) inputs to the moto neuron can potentiate the vicious circle. Similarly, the motor control tests elicit a contraction of the muscles of the lumbar-pelvic region including the erector spinae. A state of painful muscle hypertonus is induced which could explain the pressure increase observed on the PBU during performance of the tests in some patients. Thus, the role of pain in the dysregulation of respiratory movements cannot be underestimated. The

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altered breathing patterns observed in some patients are most probably related to an instinctive preventive avoidance behavior in individuals knowing and anticipating that such postures or motions might be painful.

The only different variable between the two populations studied is the presence or absence of lumbar pain. The VAS score is indeed amazingly low and in contrast with the inclusion criteria of patients with “chronic pain which was of sufficient intensity to limit function and for which they had sought medical treatment”. It should also be noted that the average duration of LBP in the cohort recruited by the authors was 13 years. In such disabled patients the pain parameters are multi-factorial, including the complex effects of peripheral and central sensitisation. In this line, it is well known that pain-related fear strongly influences the behavioral performance in this category of patients.

It should also be noted that almost half of the patients kept a normal breathing during the tests which tempers the interpretation of the results. Information on males and females reported separately would have been useful as well

as on the types of asynchronous breathing patterns observed. One can also question whether the significant increase of the pressure rates observed on the PUB in some patients could have suggested the presence of LBP and then negatively influenced the blinding of the trained examiner.

The main and most important clinical relevance of this study is to remind clinicians and physiotherapists that a lack of coordination between breathing and postural motor control of the lumbo-pelvic region may take place in some LBP patients. Consequently, revalidation of the respiratory function by appropriate inspiratory muscle training should be included in the rehabilitation programs of low back pain. The authors also allude to the fact that respiration-induced intradiskal pressure changes related to diaphragmatic and abdominal muscle activities may play a role in the nutrition of the disk. It is indeed admitted that abnormal mechanical load can lead to disk degeneration. Moreover, the disk cells need a correct oxygen supply, the disk metabolism functioning mainly through glycolysis.