

Techniques for measuring the activity of the deep muscles: Literature review

SUMMARY

Due to their anatomical positioning, contraction of the deep abdominal muscles is often difficult to feel and therefore for patients to master. However, they are actively involved in spinal (or lumbar spine) stabilisation, and also in several biological processes [1]. They therefore constitute an important target in several physiotherapeutic treatments [1]. Questions are often raised regarding the assessment of their impact on these pathologies due to the lack of reliable tools dedicated to the measurement of correct contractile activity. Here we will review the various techniques currently available to assess this muscle activity.



Value in detecting deep muscle activity

During physiotherapeutic treatment, an assessment of the contractile synergy of the abdominal wall muscles is essential in order to develop a diagnosis, draw therapeutic objectives and also ensure correct patient rehabilitation. In some cases, functional deficiencies can involve several muscle groups, including some anatomically deep ones, which can impede diagnosis and therapeutic treatment. As a result, it is important for practitioners to have available accurate and reliable techniques to assess the activity of these deep muscles in order to identify the relevant and suitable therapeutic plan.

The transverse abdominis, the deepest muscle of the abdominal wall, plays an essential role in lumbar spine stabilisation [2] [3], but also in the respiration and digestion processes [2] [3].

During diagnosis, it is crucial to assess patient capacity to recruit this muscle in order to offer suitable therapeutic exercises and speed up recovery [4] [8]. According to the scientific literature [3] [6], palpation 5 cm inside the superior iliac crests can establish an initial functional diagnosis of the transverse abdominis. This technique is currently the most commonly used during physiotherapy sessions to check the activation of the transverse abdominis. Nevertheless, palpation remains an operator-dependent technique and it can be impeded by patient morphology. A partial or erroneous assessment of the transverse abdominis muscle's activation status can impede physiotherapeutic diagnosis and even result in below optimal treatment [6]. So, are there other means or tools to evaluate and assess the contraction of this muscle?

Placing ourselves within the context of common office practice, here we are not assessing the imaging techniques used to detect muscle injuries. These require the use of very costly imaging tools that are difficult to access dynamically and as a first-line treatment, such as MRI [1].

▶ Electrical activity- EMG

The biological process underlying muscle contraction involves a transformation of chemical energy, supplied to the muscle by movement or effort, as action potentials (sudden changes of electrical potential in the muscle cell membrane – motoneuron). These action potentials created in each muscle cell then spread along the muscle fibres. They then slide against each other and drive the muscle contraction.

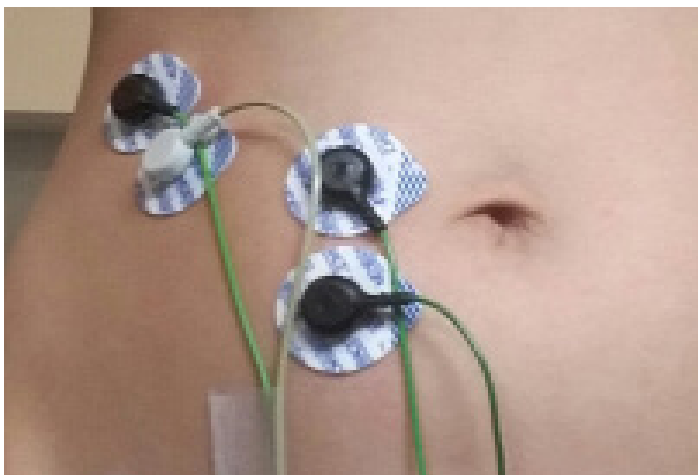


Figure 1: EMG electrodes

A method currently used to measure muscle activity is surface electromyography or EMG. This technique consists in placing electrodes (figure 1), which register the electrical signal that is present and that evolves according to the muscle activity.

Although Surface EMG is sensitive to interference, in contrast to needle EMG, it represents a practical and non-invasive alternative for studying the neuromuscular system during dynamic movement. The international recommendations of the SENIAM [13] [14] provide information on the best positioning for electrodes depending on the muscle being assessed, in order to register the most accurate EMG signal and reduce the artifacts inherent to the EMG tool. These recommendations do not include positioning for the assessment of the transverse abdominis muscle. This is because the muscle's deep anatomical position results in an electrical signal that is difficult to interpret, thus compromising the direct use of this method. Several teams have used it, particularly in conjunction with the internal oblique, emphasizing that there could be a risk of crossed signals with other muscles [5].

▶ Ultrasound



Figure 2: Ultrasound image

More recently, the use of ultrasound as a method of detecting muscle activity has proven its value. By using the properties of ultrasound and the Doppler effect,

it is possible to assess muscle activity by measuring its thickness, which describes the recruitment of a greater number of muscle fibres in comparison to a state of rest [7]. Several teams have used it to demonstrate the activation time of the transverse abdominis in pathological conditions, such as chronic low back pain [9]. This is the so-called “gold-standard” technique for assessing the contraction of the transverse abdominis, and thanks to the associated image (figure 2), it possible to resolve cases where the patient does not understand the instructions [6]. However, its use remains relatively restrictive and requires experienced practice [7], particularly in relation to the positioning of the probe (which must be in constant contact with the image area and immobile) and the measurement standards.



Pressure

Marketed by DJO Global, under the brand Chattanooga, the Stabilizer Pressure Biofeedback (figure 3) can indirectly assess whether patients are recruiting their transverse abdominis. It measures the pressure exerted on the cushion while positioned under the lumbar vertebrae, by instructing patients to draw in their stomach, without increasing the pressure. Several teams have used it in comparison with ultrasound [3] [10], demonstrating its usefulness. It is an effective method, but it is difficult to implement if the patient does not understand the instructions. Moreover, like ultrasound, it cannot be used to perform static manoeuvres.



Discussion

These methods can all be used to perform a one-off assessment of patient capacity to recruit the transverse abdominis muscle. They can therefore be used to monitor your rehabi-



Figure 3: Stabilizer Biofeedback Pressure

litation programme and identify any possible difficulties.

However, none of them can be used as part of a quick and easy dynamic application, while giving physiotherapists freedom of movement and focus. Furthermore, some teams question the effectiveness of the clinical assessment of these methods in detecting transverse abdominis [11] [12] activity. Although the role of the transverse abdominis in spinal stabilisation and support remains controversial, there is currently no tool that can determine its activity in real time, simply and visually. The provision of such a tool could settle this question.

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