Differences of maximal isometric force between different trunk angles and different movements in women

Alexandru Straton[1], Gheorghe Cismaş[2]
[1]*Faculty of Physical Education and Sport, "Ovidius" University, Constanța*
[2]*National Academy of Physical Education and Sport, Bucharest*

Abstract

Background. The identification of force differences of antagonist muscles in the spine and the determination of optimal coxofemoral joint angles in the performance of flexion, extension, lateral flexion and lateral rotation, in which maximal isometric force is generated, are necessary for the correct optimization of rehabilitation training, particularly from the point of view of the volume of work.

Aim. The aim of the study was to determine the differences (if any) in maximal isometric force between the antagonist muscles required for the performance of trunk movements, as well as to determine the optimal angles at which the highest maximal isometric force value can develop, in various planes, in the spine of sedentary female subjects of Romanian nationality.

Methods. The study group included 21 sedentary white female subjects of Romanian nationality, aged between 30 and 40 years, without any acute or chronic pain in the spine. Body height was estimated with a 0.5 cm error and body weight was assessed using a calibrated digital scale (Exacta, Germany). The body fat percentage was evaluated using the bioelectrical impedance method, with an Omron BF-306 body fat monitor. At the thoraco-lumbar level of the spine, the maximal isometric force was estimated, for extension with a David F 110 Lumbar/Thoracic Extension device, at 0º and 30º angles, for flexion with a David F 130 Lumbar/Thoracic Flexion device, at 0º and 30º angles, for lateral flexion with a David F 150 Lumbar/Thoracic Lateral Flexion device, at -30º, 0º and 30º angles, and for lateral rotation with a David F 120 Lumbar/Thoracic Rotation device, at -30º, 0º and 30º angles.

Results. The maximal isometric force assessed at a 30º angle was significantly higher during flexion (t=12.737) and extension (t=11.155), compared to the 0º angle. The maximal isometric force exerted by extensor muscles at 30º (t=6.393) and 0 (t=3.786) angles was significantly higher compared to the flexor muscles of the trunk. The highest maximal isometric force value was found at a 0º angle for lateral flexion (F(2, 40) = 260.427 for right lateral flexion, F(2, 40) = 163.262 for left lateral flexion) and at a -30º angle for lateral rotation F(2, 40) = 175.024 for right lateral rotation, F(2, 40) = 182.046 for left lateral rotation). The maximal isometric force corresponding to the muscles activated during left lateral flexion was significantly higher at the angles of -30º (t=3.616), 0º (t=5.566) and 30º (t=2.876), respectively, compared to the maximal isometric force corresponding to the muscles activated during right lateral flexion.

Conclusions. The optimal angles, at which the highest maximal isometric force values were found at the thoraco-lumbar level of the spine, were 30º for flexion and extension, 0º for lateral flexion, and -30º for lateral rotation. The force exerted by the extensor muscles of the spine was significantly higher than the force exerted by the flexor muscles of the spine in female subjects. The maximal isometric force developed by the muscles responsible for left lateral flexion was significantly higher than the maximal isometric force developed by the muscles responsible for right lateral flexion, which can be due to the dominant upper and lower limb or to the incorrect postures adopted by the subjects during the performance of various daily life tasks.

Key words: maximal isometric force, muscle, spine, flexion, extension, lateral flexion, lateral rotation, women.