A Magnetic Resonance Compatible Knee Extension Ergometer

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Abstract
The product of this thesis aims to enable the study of the biochemical and physical dynamics of the lower limbs at high levels of muscle tension and fast contraction speeds. This is accomplished in part by a magnetic resonance (MR) compatible ergometer designed to apply a load as a torque of up to 420 Nm acting against knee extension at speeds as high as 4.7 rad/s. The system can also be adapted to apply the load as a force of up to 1200 N acting against full leg extension. The ergometer is designed to enable the use of magnetic resonance spectroscopy and imaging in a three Tesla Siemens Skyra MRI system. Due to the electromagnetic limitations of having the device operate inside the magnet, the design is split into two components. One designed to fit inside the 70 cm bore of the scanner. This component is electromagnetically passive; made out of materials exhibiting minimal magnetic interference, and having no electrically powered parts. The other component is electromagnetically active; it contains all of the powered elements and actuates the passive part from another room. A tensioned cable transmits power through a waveguide; a pipe through the wall of the MRI room with an RF shield. The device was tested applying a sagittal plane moment on the knee joint during isometric, isokinetic, isotonic, and constant power contractions.

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The magnetic resonance images and T2 relaxation time profiles taken 4 weeks after surgery for both the PLGA− and PLGA+ group did not reveal the tissue reconstruction. After 12 weeks of treatment T2 time dependence indicates a slight reconstruction for PLGA+ group. Given that we have reached a point in the field of muscle energetics where absolute measurements are warranted to take the area forward, we designed an ergometer, including two force and two displacement transducers, allowing dynamic and isometric knee extension within a MRI system and accurate measurements of power output. On the basis of repeated measurements, the force and displacement transducers accuracy was.

Magnetic Resonance & Image Analysis Research Centre, University of Liverpool, Liverpool, UK. 4School of Health Sciences, Liverpool Hope University, Liverpool, UK. 5Department of Internal Medicine and Cardiology, University of Leipzig – Heart Center, Leipzig, DE. Computer-controlled electromagnetically braked knee-extension ergometer (MRI Ergometer Up/Down, Lode BV, Groningen, The Netherlands) customized for use at 3 T by the addition of extended carbon-fibre lever. Prone knee extension, where the work of stabilizing the torso is minimized by the body position, the ergometer, and the heavy strapping used to isolate quadriceps activity. Nonetheless, the work of ventilation during prone knee extension may still contribute a meaningful.

Magnetic resonance imaging (MRI) is an important tool for cardiac research, and it is frequently used for resting cardiac assessments. However, research into non-pharmacological stress cardiac evaluation is limited. We aimed to design a portable and relatively inexpensive MRI cycle ergometer capable of continuously measuring pedalling workload while patients exercise to maintain target heart rates. We constructed and tested an MRI-compatible cycle ergometer for a 1.5 T MRI scanner. The MRI-compatible cycle ergometer constructed by our research group enabled cardiac assessments at fixed heart rates, while continuously recording power output by directly measuring pedal force and crank rotation.