Category: Life sciences, Pharmacy & Medicine

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Myotones -portable device for monitoring the biomechanical properties of skeletal muscles

The device measures the passive characteristics of near-surface skeletal muscles as it would be done by palpation, checking for areas of tension and hardening in the muscles. The vibration of the muscle is measured digitally via placing a mechanical stimulus on the skin surface. The gathered data provides precise information about the elasticity, stiffness and tone of the examined resting muscle. Therefore, it is possible to determine the state of muscles objectively, quickly and easily – this hasn't been possible up to now.

The technology was developed for space applications allowing for monitoring the physiological parameters of astronauts and provides data to monitor and evaluate the success of countermeasures against muscular and bone atrophy before, during and after the astronauts' sojourn.

The instrument will be the first to investigate the effects of microgravity on resting muscle tone and the associated fascial and tendon structures that make up the human resting muscle tone (HRMT) system. Normal muscle tone is a likely indicator of a normal state of health that is obviously altered in clinical populations due to wear and tear, pain, inflammation, or injury (known as muscle stiffness, rigidity, or fatigue). Altered muscle tone is usually detected in clinical practice by inspection and subjective palpation.

The probe of the device is positioned over a specific superficial muscle at previously marked skin points. In this way, muscle tone data is automatically acquired muscle by muscle and immediately stored by the device in near real time. Ultrasound images are also acquired to document the anatomical configuration of the muscle itself, tendons, fascia and other soft tissue components from the same skin point region. All data (biomechanical and ultrasound) are transmitted via downlink and analyzed by the on-site scientific team. Data analysis includes important biomechanical parameters such as muscle tone, elasticity and stiffness at rest or image analysis of biological soft tissue dimensions.

On Earth, the findings can be used to optimise rehabilitation and training programmes, and for the objective assessment of the success of training in fitness regimes and competitive sports. For example, around a quarter of production losses in consequence of incapacity to work (in total ~ 64 billion € in Germany in 2015) are caused by diseases connected to muscles, bones and connective tissue. Taking this into account, it is crucial to optimise therapies, training programmes and to conduct an objective and efficient evaluation.

The device was designed in collaborative project. Project management and lead is hold by German researchers focussing in space medicine. Furthermore, British experts for the musculoskeletal system are involved. Technical expertise is provided by a company from Estonia.

The device is lightweight (240 g) and does not require much space (162 x 67 x 28 mm). The technology has already been tested in space experiments about human physiology by Alexander Gerst in 2018.

Innovative Aspects:

During spaceflights the astronaut's muscles cannot be diagnosed by a doctor. The project's technology fills that gap by rapidly providing consistent data about skeletal muscles by the help of a device that is easy to use.

It can also be groundbreaking for terrestrial applications. To date, medics diagnosis bases on palpating the musculature. This is subjective to some extent and no consistent data is provided. Detailed information, e.g. about muscular efficiency, required to remove muscular components and to analyse them in the laboratory.

Application Areas:

- Accelerated muscle and bone atrophy
- Observe aging processes in fast motion
- Good basis for clarification of involved processes

Cooperation:

Collaboration partners interested in further developing and commercializing the device for continued terrestrial use are especially sought.