

Made to measure, measurements in modern anatomy make the
difference in helping to develop new medical technologies

Non Peer-reviewed author version

VAN ZWIETEN, Koos Jaap (2009) Made to measure, measurements in modern
anatomy make the difference in helping to develop new medical technologies. In:
Public Service Review: Science and Technology, 5. p. 237-238.

Handle: <http://hdl.handle.net/1942/10337>

Made to measure

Measurements in modern anatomy make the difference in helping to develop new medical technologies, as the University of Hasselt's Koos Jaap van Zwieten explains...

From the very early days of establishing modern anatomy by its 'founding father' Brussels-based Andreas Vesalius (1514-1564), functional morphologists worldwide have been driven by a constant search for clear observation and indisputable description of even the most minute detail.¹

Since the dawn of the new millennium, some universities have taken the opportunity to share knowledge and expertise with universities over the borders by means of a so-called transnational university – a quite unique European endeavour.

This joint effort over the years has raised a new generation of eager scientists – BSc, MSc and PhD students of Biomedical Sciences alike – some of whom have been temporarily involved in performing meticulous measurements in anatomical specimens, thus carrying forth the torch of observing relatively new and irrefutable anatomical details. Results of their measurements can almost immediately be applied in refining medical equipment, used by departments of surgery, neurosurgery and rehabilitation in clinical services, hence transnational interuniversity cooperation has a strong impetus on the health and wellbeing of European civilians.

The development of new medical approaches, preceded by observations in anatomical specimens, is part of a long-standing tradition.² In previous years, 2D measurements were performed to determine the critical surfaces of surgical meshes with given material properties (plastic) in order to repair by laparoscopy the resulting tissue lacunae that are caused by pre-existing abdominal wall hernias.³

Next, measurements were concerned with the 'efficacy' by which lower arm muscles contribute to the development of repetitive strain injury (RSI), a much dreaded disorder in PC workers.⁴ Pilot studies had already been performed concerning the effect of low frequency vibrations on soft tissues, to analyse their possible healing effects on neuromuscular disorders.⁵ By combining this basic anatomical and physical data, the positive effects of vibration therapy on the diminishing of pain while increasing muscle strength in RSI patients was shown.⁶

Results were brought forward at European conferences and published in European-based scientific journals.

To attack the problem of chronic, intractable low back pain with its heavy economic burden on society, an original idea from the 60s of spinal cord stimulation – also known as neuromodulation – was tried, following morphometry studies performed by other universities. The pain-soothing working mechanism of neuromodulation can be explained as follows.

‘Electro stimulation can be applied...to enhance the strength of some selected agonist muscles, simultaneously with vibration stimulation of their antagonists, thus creating a ‘win-win situation’.’

We experience more warmth the closer we come to an open fire. In a comparable way, micro-electric fields, caused by surgical electrode leads – provided that they are placed closely enough to the spinal cord – do ‘block’ pain.

It must be kept in mind that most of our spinal cord has only the calibre of a robust pencil, so that for today’s refined multi-polar micro-electrode leads, just fractions of millimetres are left to have their various intensities exerted on pain-conducting nerve bundles. Other neuroscience research groups had previously done the job of counting individual nerve cells, measuring their diameters in the outer layers of the spinal cord, thus predicting some of the neuromodulation effects described above.⁷

As a final example of positive developments, again resulting from combining two or more separate positive factors, the hitherto unknown technique of electro vibrostimulation was introduced in western society in the late 90s by a much cited study.⁸

Most of our movements are caused by muscles, each with its own function. Muscles initiating a movement in a certain direction are agonists, while muscles with effects

in the opposite direction are the antagonists. Normal fluent human motion consists of a constant delicate balance of the agonists' and antagonists' actions. Now if a certain human movement is not powerful enough, this may be so because agonists are too weak, or antagonists are too strong, or both. An original East European concept to overcome such a disorder is to stimulate agonist muscles while simultaneously relaxing their antagonists. Relaxation of muscles by means of vibration therapy had already been shown.^{9,10} The stimulating effect of micro-currents had also been proven.¹¹

Electro stimulation can be applied (externally, on the muscles this time) to enhance the strength of some selected agonist muscles, simultaneously with vibration stimulation of their antagonists, thus creating a 'win-win situation'.

In many endurance sports such as running, cycling, rowing, etc., alternations of agonist-antagonist movements play a central role, especially in the lower extremities. Such activities may also be helpful to improve muscle strength during post-operative rehabilitation in patients.

In a recent study, effects of electro vibrostimulation training were therefore compared with classical power training in a group of 18-24 years old healthy sportsmen. 26 subjects were divided randomly into three groups: an electro vibrostimulation group, a placebo group, and a reference group that continued its usual training. The study was approved by the university committee for medical ethics.

'...most of our spinal cord has only the calibre of a robust pencil, so that for today's refined multi-polar micro-electrode leads, just fractions of millimetres are left to have their various intensities exerted on pain-conducting nerve bundles.'

After four weeks of electro vibrostimulation, applied twice a week, there was a significant increase of isometric strength in the electro vibrostimulation group. This was not so in the placebo group and the reference group. The average values of joint flexibility in the three groups showed no significant modification. Further, a significant increase in explosive muscular strength was noticed in the electro vibrostimulation group. This was not so in the placebo group or the reference group.¹²

We are convinced that these few examples have made clear how new measurements, carefully carried out, in a traditional domain like human anatomy, may directly

contribute to useful application in the field of modern medical technologies.

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