Academy of PHYSICAL MEDICINE

Broadcast Summary

Rehabilitation and Technology

Jon Graham

About John Graham

- Qualified in Physiotherapy from the University of Teesside with distinction
- Holds a master's degree in Cognitive Psychology
- Clinical Director of PhysioFunction covering the Midlands, including Northamptonshire, Buckinghamshire and Bedfordshire, and London. Role involves clinical mentoring of his growing team of highly specialist Physiotherapists, clinical research and business development
- Manages the PhysioFunction FES outreach clinics Chester and Brighton
- Recognised as an international expert in Neurological Physiotherapy, Rehabilitation Technology and Exoskeletons
- Acts as an Expert Physiotherapy and Rehabilitation Technology Witness, producing Medico-Legal Reports for Solicitors and Rehabilitation Needs Reports for Case Managers and other health professionals
- Has published articles in physiotherapy and neurological nursing journals
- Frequently requested Professional Speaker and clinical educator both in UK and abroad
- Principal Physiotherapy Investigator for the REX Bionics RAPPER II trails

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Technology for rehab

• Physiotherapists back in the 80's and 90's used a lot of equipment in their departments with some very dubious clinical research behind it.

• Ultrasound, shortwave, and microwave diathermy are still widely used.

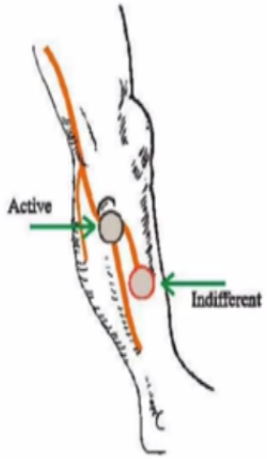
• The use of interferential therapy is significantly reduced as there has been no good evidence that shows its clinical benefits. But it is 30 percent better than placebo.

Rehabilitation triad

Three treatment modalities: hands on work, technology, and exercise therapy. The appropriate balance of these components varies for each client at each point in their recovery.

Types of technology

1. Functional Electrical Stimulation (FES)



• Method of applying low level electrical currents directly to the motor nerves of the body to restore function.

Demonstration of the first application of FES in patients with varied injuries that shows the difference it makes on speed and functional movement (without FES and with FES)

- FES and stroke (04:37 – 05:06 in the broadcast)
- FES and MS (06:06 – 06:34 in the broadcast)
- FES and incomplete spinal injury (06:53 – 07:16 in the broadcast)
- FES and ABI (07:32 – 08:01 and 08:16 – 08:28 in the broadcast)

2. TurboMed orthosis for foot drop

• A foot orthosis for everyday uses and for outdoor or vigorous physical activities.

• Designed to restore autonomy and comfort to patients with foot drop.

• Can be fitted to business shoes, training shoes or boots.

Demonstration of the difference in movement with and without TurboMED FS3000 orthosis in patients afflicted by foot drop.

- Drop foot Case Study #1 (08:46 – 10:32 in the broadcast)
- Drop foot Case Study #2 (10:36 – 11:33 in the broadcast)

Demonstration of how TurboMed device can help patients afflicted with foot drop.
(14:09 – 23:29 in the broadcast)

Model patient

- 86-year old man
- Lumbar fusion at L4-5 in 2003 due to chronic, severe back pain
- Recently afflicted with sciatic pain with a degree of foot drop

Muscle stimulator is attached on the skin above the fibular head (over the peroneal nerve) to give it a boost. Frequency is set at 40 hertz, and pulse duration of 300 milliseconds. This test determines whether or not the nerve is still functional, which in this case, it still is.

The TurboMed device is attached to the footwear. In terms of mechanism, it will effectively provide an upward force to the foot so the heel strike will drop it down. As the foot is lifted, the splint will bring it into dorsiflexion (1 or 2 degrees of extra functional dorsiflexion can make a difference).

• FES can help even 10-12 years after a stroke. The only difference when it is longer, is there may be tightness in the calf which needs more preparation before the FES works. A 6 to 8-week lead for strengthening exercises may be needed.

• There have been documented good results with FES in patients 15-20 years post-stroke.

Cost difference between the splint and FES

The non-wireless version of the FES is about the same price as the splint which is about £750, while the wireless version is about £1200.

3. Wireless heel switch (muscle & nerve stimulation)

(25:27 – 29:37 in the broadcast)

• This device is used to deliver stimulation to the muscle over a long period of time. As strengthening occurs over time, the electrical current is reduced.

• A control box is wirelessly connected to the sensor worn in the shoe (heel switch) which detects pressure changes as the foot starts to move. The power switches on as the heel lifts then the electrodes attached to the skin below the knee deliver electrical signals to the leg. This causes dorsiflexion when taking a step and helps prevent dragging the foot on the ground.

4. Cheap electrical stimulators

• This device is used here to stabilise the wrist of the patient. Can be used 20 minutes a day every day for a month. It is a means for patients to do repetitive exercise to gain the much needed functional control of the muscle.

• It is a domiciliary device; patients can use throughout the day and get many hours of effective therapy without requiring any clinical personnel to assist them.

• It is commonly available now in stroke rehabilitation units. (When individuals have stroke, certain areas in their brain get inflamed and the first 3-6 months of therapy is very often focused on resolution of swelling. Anything beyond that is new learning - retraining the brain to do something physical).

5. Virtual reality software

Research has been directed at the clinical potential of virtual reality software to aid in patients' rehabilitation process (i.e. re-training the brain).

Examples

Microsoft Kinect	Nintendo Wii	Immersive VR	MindMotion Neurorehabilitation platform
• Has infrared sensor that picks up limb segments	• Does not accurately read motion activity	• Enables user engagement in an artificially created environment (head mounted display) - replicates the feel of real-world interaction (i.e. picking up objects,	• Developed in Switzerland, this platform delivers neuroscience-rooted motor rehabilitation exercises aimed at activating targeted neural pathways and balancing the interhemispheric brain activity

		etc.) • Very expensive • Could exaggerate issues in someone who had a brain stroke	• uses camera-based motion tracking technology and virtual environments to provide advanced motor rehabilitation

The motion tracking system allows precise quantification of patients' movements, allowing measuring of treatment dose and adherence. The system also gives prompt visual feedback.
<www.mindmotionweb.com>

The use of this type of virtual reality software has positive results in patients with familial spastic paraplegia.

6. BPMpro - body performance measures

• This software gives information on the degree of joint mobility and power as basis for making correct diagnosis and rehabilitation programme. Menu includes patient database (case history, test results, etc.); movement test selection (dorsiflexion, plantar flexion, inversion, aversion, knee flexion, extension, hip rotation, etc.); and different ranges of movement, among others.

• It can measure the direction, rotation, speed, acceleration, force, power, and endurance of the body to be observed, recorded, and analysed.

• It automatically logs test results to the patient's database and can produce graphical presentation of the rate of patient improvement over the course of treatments.

• The medico-legal aspect of this is that the software can provide evidence of treatments administered and the graphical illustration of the changes on the patient as a consequence of those treatments.

• The sensor, software, and a set of straps cost £300 from the manufacturer's website. Can be installed in tablet or laptop.

FES and incomplete spinal cord injury at C5/6

• If the patient is still able to walk a few steps but is troubled with foot drop due to weak quads and hamstrings, then a single channelled device can be used for stimulation. For more complex conditions, two-channeled device with 3-4 stimulators can be used.

• The combination of FES and cyclic ergometer works well for individuals with very high level of near complete spinal injury. The individuals will have to pull their wheelchairs up to the ergometer, have their feet positioned on the pedals, their legs are driven by the FES. The FES pads are placed on their quads, hamstrings, and glutes. This procedure only allows the muscles to work strongly to then get the metabolic benefit, but does not get them out of the wheelchair.

• Patients with spinal injury have higher than normal rates of diabetes, possibly due to the absence of activities in the glutes and quads, which have a significant role in the metabolic system.

• The level of diabetes in paraplegics is not particularly different to the level of diabetes in tetraplegics. Through FES, muscle bulk can be maintained, reducing the risk of pressure sores, and improving the metabolic function in the muscle, hence reducing the risk of diabetes.

• FES is contraindicated in people with uncontrolled epilepsy. It is indicated only if the epilepsy is controlled by medication.

• FES is contraindicated in pregnant women.

Recommended device for patient analysis

• Since most of the clinicians are not going to acquire those FES and wireless devices for their clinics, they can purchase a muscle stimulator (£30) just to aid in the initial assessments to see if the patients are suitable for treatment and if they respond to the electrical stimulation.

• For specific home muscle stimulator, the IntelliSTIM – BE28E is recommended.

Rehabilitation technology (REX)

• An improved version of the REX is currently a work in progress – a prototype is expected to be released in the middle of this year.

• REX is designed to help patients with a range of neurological conditions including spinal cord injuries and MS.

National Foot Drop Society

• Aims to raise awareness and alleviate unmanaged foot drop. The first national foot drop awareness campaign is scheduled for 21st September 2018 (further details to follow).

• The goal is to let people with movement impairments (i.e. post-stroke, post-traumatic head injuries) to try the rehabilitation technology/devices available and see what will suit them best.