Neuromuscular Electrostimulation (NMES)

An adjunct to expedite recovery and performance (Abridged)
Cliff Eaton MSc MCSP

- Professional sport
- UK Athletics
- L.C.C.C.
- Northampton Saints
- Sale RFC
- M.C.F.C.
- DJO Global
What is required of a motor nerve to initiate muscle stimulation?
• A stimulus, such as an electrical current, can also activate the protein molecules that act as voltage gates resulting in action potentials in the motor neurones.
Optimal impulse vs other currents

- Faradic current:

- Träbert:

- Bernard:

- Russian: (Kotz)

Not used for EMS...

- Shape: I and t?
- Pulse duration?
- Comfort: ???
- Safety?
From the 80’s:

- Rational approach based on scientific understanding
- Identification of the ‘Optimal impulse’
- **Safe, comfortable, efficient** NMES current!

**Optimal impulse**

![Optimal impulse graph](image)

**Comfort +++**

**Efficiency +++**

**Poor impulse**

![Poor impulse graph](image)

**Comfort -**

**Efficiency -**

"Catastrophic" impulse

!["Catastrophic" impulse graph](image)

**Comfort 0**

**Efficiency 0**
An international scientific consensus:
Symmetrical, rectangular, bi-phasic, fully compensated current

- **Vertical ramp**: instantaneous current installation

- **Rectangular shape**: most energy for least I and t

- **Compensated**: no polarization and no risk of burning

- **CHRONAXIA** minimal intensity with pulse width to produce action potential (Lapique’s law)

- **Constant current** generator
NMES effects on excitable tissue

- Excitable tissue, nerves and muscles, can be stimulated by currents that vary at a suitable rate (frequency)

- Effects include: muscle twitch, blood flow, contractions and altered pain perception
Indications for NMES

- Pain control
- Enhancing muscle recruitment
- Retard muscle atrophy
- Muscle strengthening
- Stimulate motor(re)learning
- Incontinence
- CV Health
- DVT reduction
- Wound healing
- Hyperhydrosis
- Oedema management
- Transdermal drug delivery (Iontophoresis)
Endorphine release

- Stimulating the motor nerves at a low frequency (5Hz) creates a muscular twitch promoting Endorphine (opioid substance) release by the hypothalamus.

- Similar to acupuncture stimulation or rubbing.
Pain Gate Theory-Classic TENS

- Melzak and Wall 1965

- Substantia Gelatinosa and T-cell (dorsal horn of SC) control nerve impulses to the brain. Only allow one impulse through at a time; like a gate.
Tetanic process

SLOW TWITCH FIBRES

FAST TWITCH FIBERS
Tetanic process - SUMMARY

Each goal has a frequency range!

<table>
<thead>
<tr>
<th>Frequency Range</th>
<th>Twitch</th>
<th>Endurance</th>
<th>CV +HR +VO2max</th>
<th>Muscle firming</th>
<th>Muscle volume</th>
<th>T.E.N.S.</th>
<th>Strength</th>
<th>Explosive Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 9 Hz</td>
<td>Reduce Mm Spam (1Hz)</td>
<td>Endorphine release (5Hz)</td>
<td>Improve blood flow (8 Hz)</td>
<td></td>
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<td>10 to 20 Hz</td>
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<td>20 to 30 Hz</td>
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<td>40 to 70 Hz</td>
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<tr>
<td>75 to 100 Hz</td>
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<td>T.E.N.S.</td>
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<tr>
<td>100 Hz</td>
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</table>
Main advantages of NMES

• Quality of muscular work
  – Stimulation patterns appropriate to an objective

• Quantity of work + + +
  – No cardiovascular stress
  – No central fatigue
  – Low constraints on joints
Electrode placement

- To stimulate a normally innervated muscle effectively (recruiting most fibres) but *comfortably* the electrode should be placed over the motor end plate.

- There are many exceptions but most motor points can often be found at the junction of the proximal third to the distal third of a muscle belly.
A cable with a sensor:

- that informs
- that monitors
- that guides you

Mi TECHNOLOGY

CHRONAXIA varies between nerves and people
CLINICAL EVIDENCE RESOURCES

- WWW.djoglobal.com – ‘My DJO’ provides access to 100s of peer reviewed abstracts

- Prof Tim Watson (Independent) has 150k on his database – www.ELECTROTHERAPY.ORG

- Anecdotal evidence
Clinical evidence

- **Is high-frequency neuromuscular electrical stimulation a suitable tool for muscle performance improvement in both healthy humans and athletes?**
  
  
  **Key message:** NMES can be considered as an efficient and relevant adjunct to traditional voluntary strengthening programs.

- **Combined Application of Neuromuscular Electrical Stimulation and Voluntary Muscular Contractions**
  
  
  **Key message:** In a combined technique program, EMS and voluntary contractions have a positive complementary effect on muscle strength and functional recovery.

- **Effects of electrical stimulation on VO2 kinetics and delta efficiency in healthy young men**
  
  Pérez, Lucia, Santalla, Chicharro (2003), British Journal of Sports Medicine
  
  **Key message:** A short term, feasible electrical stimulation protocol (18 sessions of 30 min each) can improve the work efficiency of sedentary, healthy men during a ramp exercise test.
Clinical evidence

- **Effects of An Electrostimulation Training Program on Strength, Jumping, and Kicking Capacities in Soccer Players**
  Maxime Billot, Alain Martin, Christos Paizis, Carole Cometti, Nicolas Babault (2010)
  Journal of Strength and Conditioning Research
  **Key message:** 3 to 5 weeks of EMS added to the traditional training program has significantly beneficial effects on muscle strength and specific soccer skills such as kicking speed.

- **Effect of combined electrostimulation and plyometric training on vertical jump height**
  Maffiuletti, Dugnani, Folz, Di Pierno, Mauro (2002)
  Medicine & Science in Sports & Exercise
  **Key message:** EMS combined with plyometric training has proven useful for the improvement of vertical jump ability in volleyball players

- **Electromyostimulation-a systematic review of the influence of training regimens and stimulation parameters on effectiveness in electromyostimulation training of selected strength parameters.**
  Filipovic A, Kleinöder H, Dörmann U, Mester J (Nov 2011) JSCR
  **Key message:** Optimal strength training can be achieved by effectively combining training regimens with relevant stimulation parameters
Combining Compex with Active Exercise

**OPEN CHAIN**
- Isometric exercise
- Concentric exercise
- Co-contraction muscle groups
- Disuse atrophy
- Type I fibre bias
- 2 + 2 combining muscle stim and pain relief

**CLOSED CHAIN**
- Isometric exercise
- Concentric exercise
- Eccentric exercise
- Combined Con/Ecc exercise
- Co-contraction of muscle groups
- Type II
- 2 + 2 combining muscle stim and pain relief

**MOVEMENT CONTROL**
- Eccentric control of movement
- Proprioception
- Stretching using reciprocal inhibition
- Muscle spasm
- Low frequency (2-9 Hz)
- Afferent nerve reflex
DJO SPONSORED CPD WORKSHOPS

- 1 hour preliminary workshop on theory, anatomy, interactions and therapeutic interventions
- 1 to 2 hours practical workshops that are pathology based e.g. Compex and Shoulder pain; Compex and ACLs
- Compex 3 training
- Comprehensive 1 day workshop including all the above (Guildford)
- Followed by advanced workshop led by Prof Tim Watson, which will include wound healing
THANK YOU FOR YOUR ATTENTION

Any questions?
(Only easy ones please so as not to embarrass me!)