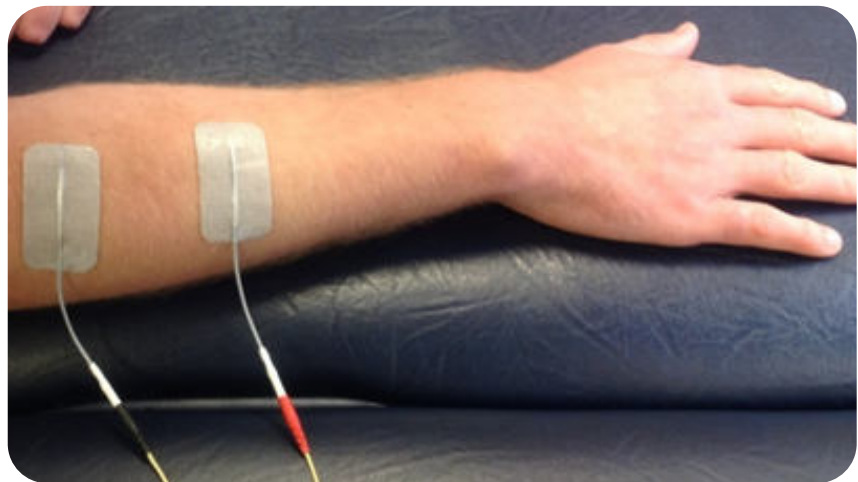
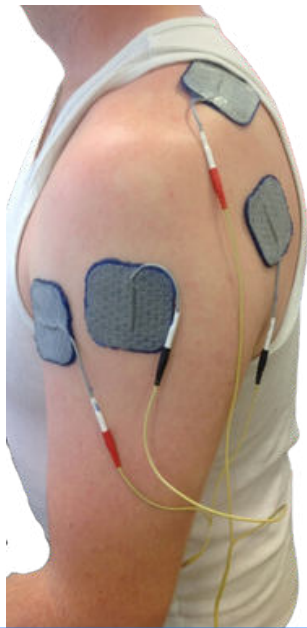


Webinar Handbook

NMES in the Upper Limb



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Course Presenter



Kim Nurcombe

Specialist Neurological Physiotherapist

What is NMES?



Neuromuscular electrical stimulation (NMES)

It is a type of electrical stimulation which causes a muscle contraction

How does it work?

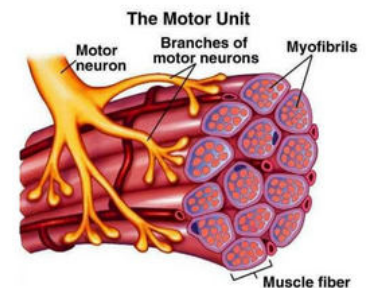
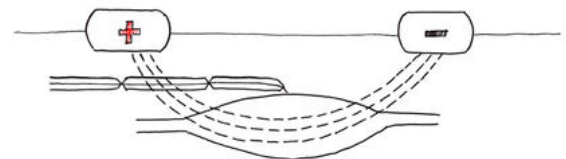
Provides electrical stimulation to the peripheral nerve/motor unit



Causes depolarisation of the peripheral neuron



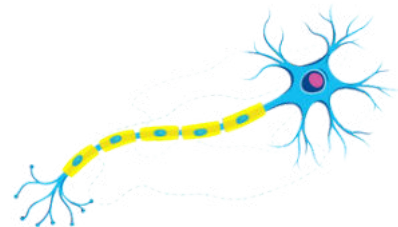
Initiates muscle contraction



What is happening?

Neuron/motor unit

Type 2 muscle fibres motor units stimulated
Antidromic impulse in an axon occurs. This is an conduction in the opposite direction to normal.



Spinal cord level

Repetitive high frequency activation of the anterior horn within the spinal cord occurs.
Hebb-type modifiable synapse - strengthened by coincidence of pre + post synaptic activity.

Cortical level

Increased activity in primary somatosensory cortex on lesion side

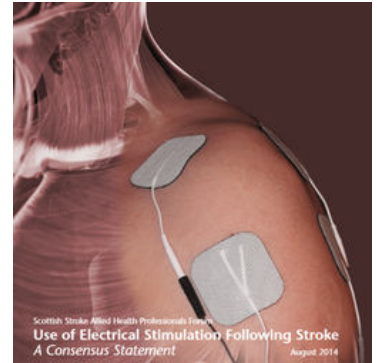


Using NMES in Practice

How do we feel about NMES?

Main barriers to using NMES in practice:

- A lack of knowledge, skills and experience
- A lack of equipment
- Funding and cost
- Time to assess or deliver NMES
- 'Not considered a priority'



Clinicians **do not feel comfortable** assessing, setting or changing NMES settings to optimise treatment

Guidelines

RCP Guidelines for Stroke 2023



Motor weakness:

'People with stroke who are unable to exercise against gravity independently should be considered for adjuncts to exercise (such as neuromuscular or functional electrical stimulation), to support participation in exercise training.'

Arm Function:

'People with wrist and finger weakness which limits function after stroke should be considered for functional electrical stimulation applied to the wrist and finger extensors, as an adjunct to conventional therapy. Stimulation protocols should be individualised to the person's presentation and tolerance, and the person with stroke, their family/carers and clinicians in all settings should be trained in the safe application and use of electrical stimulation devices.'

Evidence

Hathem 2016

'Moderate-quality evidence that **simple/passive NMES in combination with rehabilitation is superior to the rehabilitation treatment alone** with regards to upper extremity impairment (strength, range of motion)'

Stien 2015

'NMES combined with other intervention modalities can be considered as **a treatment option that provides improvements in spasticity and range of motion in patients after stroke**'

Wattchow 2018

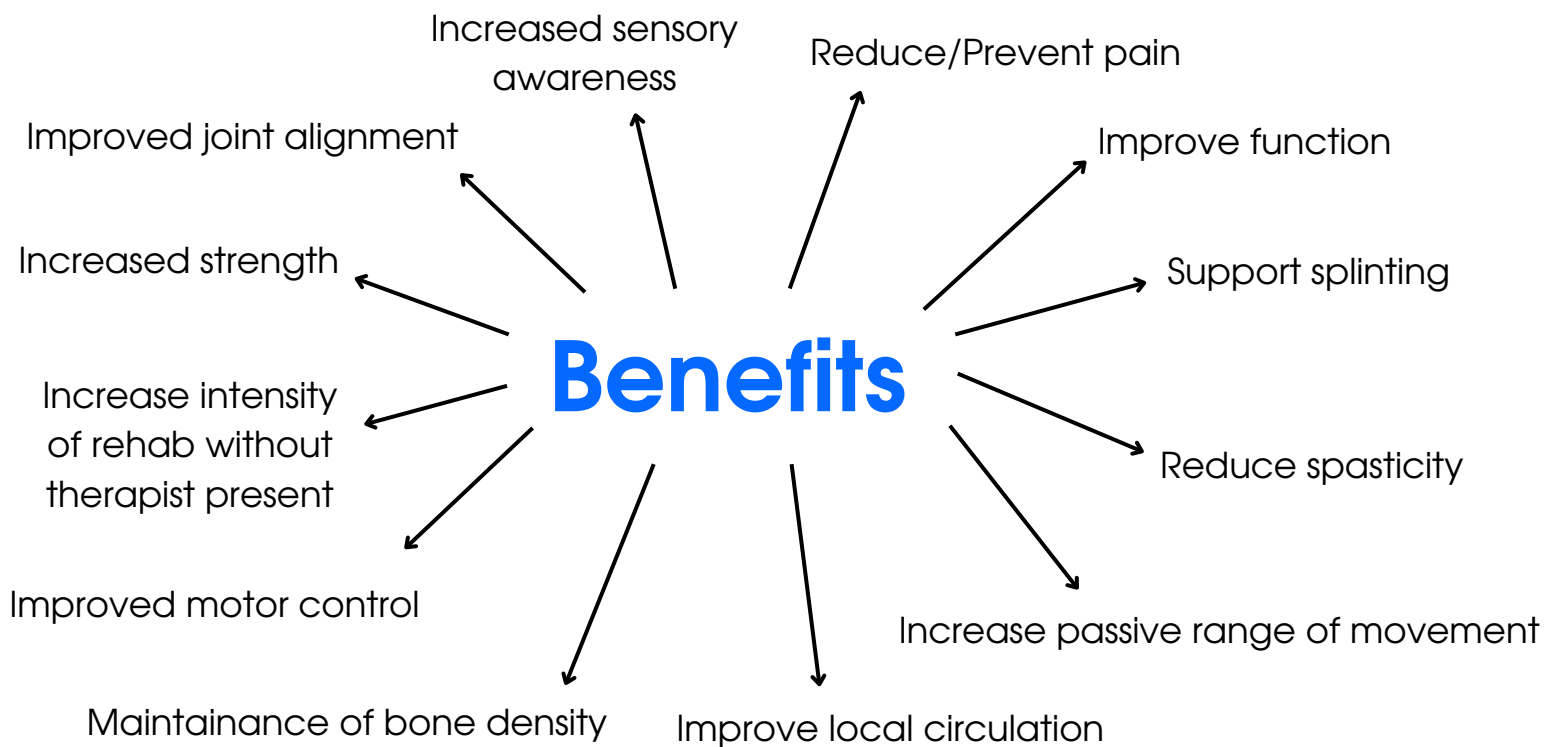
'Evidence was found to **support the supplementary use of biofeedback and electrical stimulation in first 4 weeks of stroke**'.



Using NMES in Practice

Indications for Use

- Upper motor neuron lesion/central neurological condition and peripheral neuron intact
- Shoulder subluxation in acute or chronic phase of stroke
- To support splinting of the hand and wrist
- Not able to contract muscle group against gravity or muscle fatigues quickly
- Reduced/high risk of losing range of movement
- To facilitate functional goals eg reach and grasp



Using NMES in Practice

Contraindications and Precautions

Contraindications	Precautions
Pacemaker	Epilepsy
Pregnant	Heart conditions
Damaged or broken skin	Poor skin integrity
Metal implant directly under pad position	Cognitive/communication impairment
Cancer/Malignancy	Sensory impairment
Heart monitor/Sleep apnoea monitor	Diabetes
Acute DVT	Active infection

Clinical Application

Which conditions?

YES!	?
Stroke	Peripheral nerve injury
Multiple sclerosis	Muscular dystrophy
HSP	MND
SCI	GBS
Cerebral Palsy	

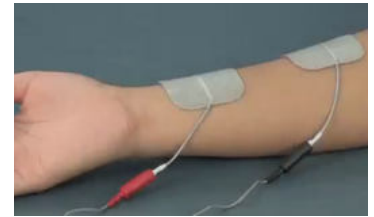


Using NMES in Practice

Considerations for Set-Up

Lowest frequency possible required to achieve a muscle response may minimise patient intolerance and maximise clinical benefit

- Settings/Mode
- Location of pad placement
- Electrode size
- Distance between electrodes
- Placement of electrodes: Active (black) vs indifferent (red)
- Skin
- Type of electrode



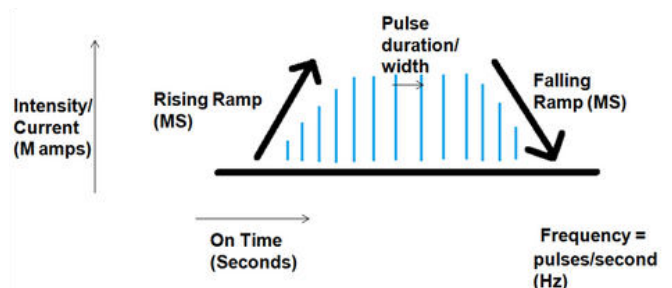
Terminology

Settings:

- Frequency: No of pulses a second
- Amplitude/Intensity/current: Strength of the stimulation given
- Pulse width: How long the pulse is delivered for
- Rising ramp: How quickly the muscle contracts
- Ramp down: How quickly the muscle relaxes.
- Time on: length of each contraction

Modes:

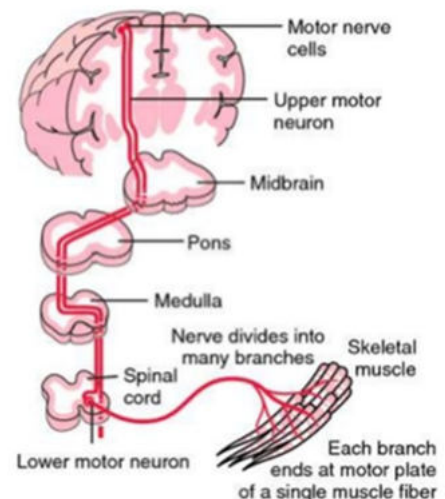
Alternate, Simultaneous or Overlapping



What Settings Should I Use?

Starting set up for Upper limb NMES:

- Frequency: 40Hz (20Hz if fatigues quickly)
- Pulse width: 200-240us
- Intensity: As required
- Time on: 7 seconds
- Rest: 10 seconds
- Ramp up: 1-2 seconds
- Ramp down: 1-2 seconds
- Mode: Overlapping/alternating/simultaneous
- (Dual channel)



Dual or single channel?



Using NMES in Practice

How much?

Dosage: No formal consensus! More studies needed!

Current evidence states...

5-14 times a week, 30-60mins at a time, 2-8 weeks, acute, sub acute and chronic phase of stroke

Shoulder subluxation start early (Within 48 hours)



Is my treatment effective?

Upper limb outcome measures:

- ARAT
- ARM A/B
- FM-UL
- CAHAI
- Goniometry - Passive range of movement
- VAS UL Function

Have they met their goals?

HELP! My NMES is Not Working?!

Problem with the communication between pads, wire and machine..

- Wipe down pads
- Clean the skin
- Replace the pads
- Disconnect and reconnect wires from pads and machine
- Replace wires
- Change batteries



Set Up for Different Locations

Scapula

Active: Rhomboids

Indifferent: Lower trapezius

Single channel

Clinical use:

- Pain management
- Increase proximal stability
- Optimise GHJT position
- Improve scapula stability
- Support upper limb in function or during transfers



Shoulder Subluxation

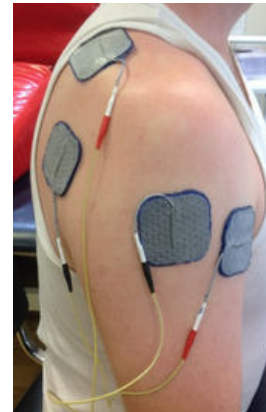
Active: Mid deltoid (1) and posterior deltoid (2)

Indifferent: Supraspinatus (1) and anterior deltoid (2)

Dual channel, Overlapping mode

Clinical use:

- Pain management
- Subluxation
- Support upper limb in function or during transfers



Triceps

Active: Mid Triceps

Indifferent: Distal Triceps

Single channel

Clinical use:

- Increase ROM into elbow extension
- Reduce spasticity in elbow flexors
- Facilitates forwards reach with wrist/finger extension
- Consider in gait or weightbearing



Set Up for Different Locations

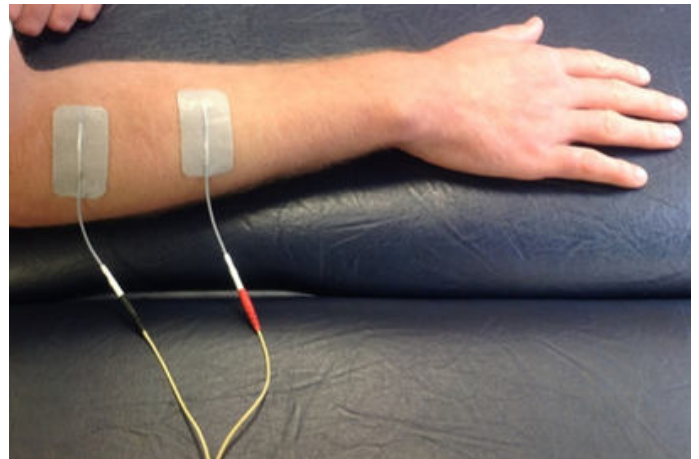
Wrist Extensors

Active: Extensor muscle bulk

Indifferent: Mid forearm

Clinical use:

- To support splinting
- Reduce wrist flexor spasticity
- Strengthen wrist extensors
- Improve muscle length of wrist flexors
- To facilitate hand opening for grasp



Reach and Grasp

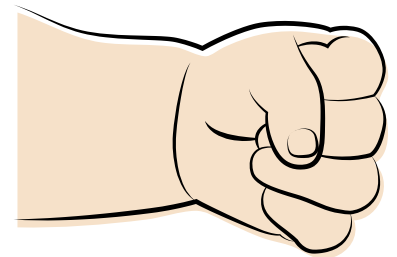
Active: wrist extensor bulk (1) and mid triceps (2)

Indifferent: Mid forearm (1) and distal triceps (2)

Dual channel, simultaneous mode

Clinical use:

- Improve elbow extension and wrist and finger extension as set up for grasp



Set Up for Different Locations

Grasp

Active: Thenar eminence (1) and wrist extensors (2)
Indifferent: Dorsal side of the hand (1) and mid/distal forearm (2)

Dual channel, simultaneous mode

Clinical use:

- To support finger extension and thumb abduction for preparation for grasp
- Used when proximally stronger than distal



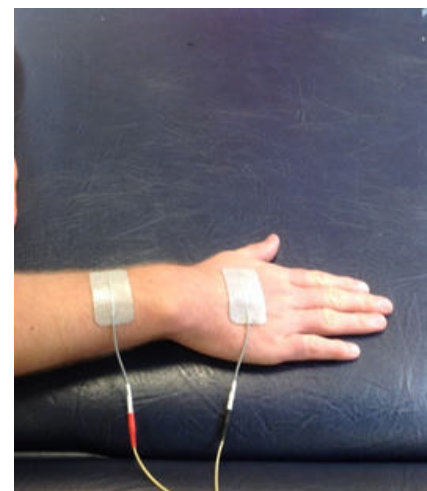
Lumbricals

Active: Over MCPs
Indifferent: Distal forearm/palmer aspect of metacarpals

Single channel

Clinical use:

- focus on hand shape and intrinsic muscle strengthening



Case Study

61 year old man
 R MCA infarct in 2020
 PMH: Epilepsy and AF

Main impairments related to UL:

- Left sided weakness
- Left sided reduced passive range of movement at left shoulder and wrist
- Spasticity into elbow, wrist flexors and finger flexors
- Reduced sensation
- Pain in shoulder and wrist on passive movement

Unable to actively open hand and hold objects
 Difficulty cleaning inside the palm and put splint on



Assessment

Type of assessment	
Type of assessment	Lower limb; Upper limb
Lower limb laterality	
Joint laterality	Left
Upper limb laterality	
Joint laterality	Left
Lower Limb Left	
Ankle PF-DP (L)	45
Inversion	30 inversion
Eversion (L)	
Elbow (L)	
Elbow flex-ext (L)	70 F
Wrist (L)	
Wrist flex-ext (L)	25 F
Wrist pron-supin (L)	20 RD

MCP's flex-ext (L)	
Index (L)	90
Middle (L)	70
Ring (L)	60
Little (L)	60
PIP's flex-ext (L)	
Index (L)	90
Middle (L)	90
Ring (L)	90
Little (L)	100
DIP's flex-ext (L)	
Index (L)	70
Middle (L)	70
Ring (L)	60
Little (L)	60
Thumb flex-ext (L)	
MCP (L)	20
IP (L)	80



Wrist	
flex-ext (60/0/60) - fingers flexed	80/0/20
flex-ext (60/0/60) - fingers extended	
Fingers - LEFT	
MCP's flex - ext (90/0/0)	
Index	90/0/0
Middle	100/0/30
Ring	100/0/40
Little	100/0/40
PIP's flex - ext (100/0/0)	
Index	100/55/0
Middle	100/90/0
Ring	100/70/0
Little	100/60/0
DIP's flex - ext (90/0/0)	
Index	90/0/0
Middle	90/0/0
Ring	90/0/0
Little	90/0/0
Thumb flex - ext	
IP (80/0/0)	90/20/0

In sitting - Left	
Elbow extensors (flexion mvt)	2
Elbow flexors (extension mvt)	2
Wrist extensors (flexion mvt)	0
Wrist flexors (flexion mvt)	3 <i>(limited range and NN changes)</i>
Pronators (supination mvt)	2 <i>(non neural feel)</i>
Supinators	0
Lumbricals (MCP ext mvt)	0 <i>(2, 0, 0, 0)</i>
FDS (PIP extension mvt)	3
FDP (DIP extension mvt)	3
Thumb flexors (extension mvt)	3 <i>(FPL - 3, fpb 1 - Opp 0)</i>
Total Score Left	18



Case Study

What are his goals of treatment?

What treatment interventions could you consider?

Would you consider NMES?

Are there any precautions/contraindications to NMES?

Where would you consider using NMES?

Treatment

1) Botulinum toxin to the following...

Flexor carpi Radialis

Flexor Carpi Ulnaris

Flexor digitorum superficialis

Flexor digitorum Profundus

Flexor Pollicus Longus

2) Physical management:

- Stretching
- Splinting
- NMES - 20mins, daily, 40Hz,

Pulse width 200us,

work time: 7 secs, rest 10 secs.



Take-Aways

- Use of NMES is supported for shoulder subluxation and wrist/fingers following stroke
- NMES is an **ADJUNCT** and should be used alongside other UL rehabilitation modalities for best results
- The results of NMES are optimised when a patient can cognitively attend and physically 'join in' with contractions delivered by the NMES
- NMES is under utilised due to resources, availability of devices, clinician experience and confidence using the device
- Optimal dosage of NMES is unclear and needs further research
- For an individualise approach, NMES should be used with solid clinical reasoning skills, patient education and engagement
- Get familiar with the devices available to you and have a go!



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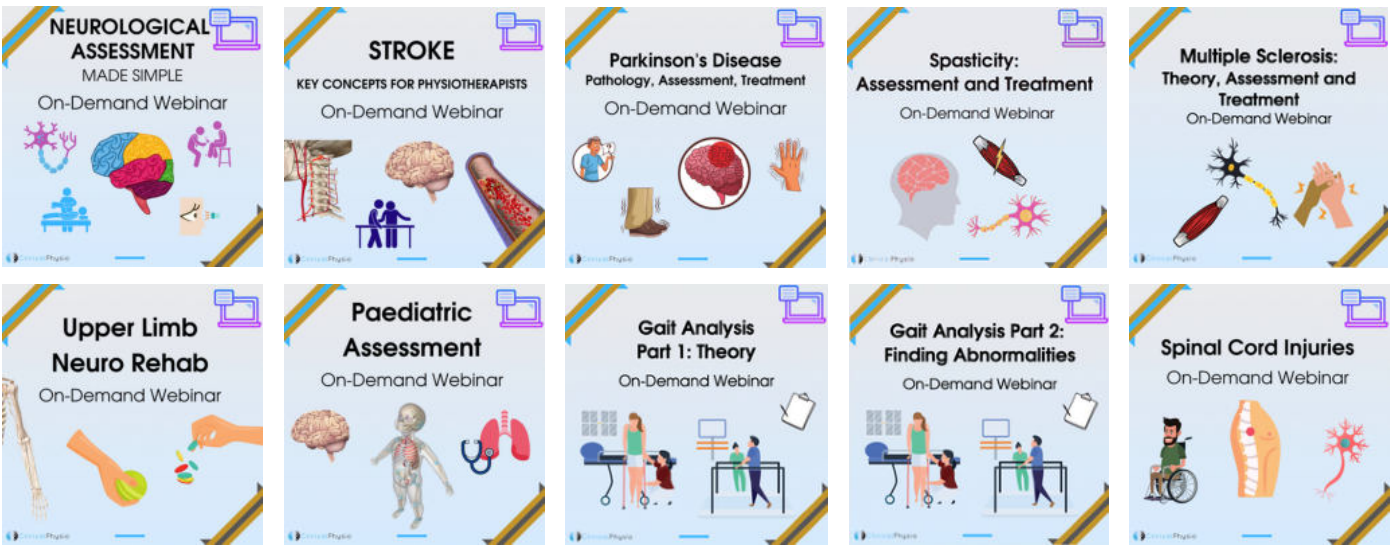
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