Electrotherapy
Marion Mueller, DVM, CVA, CCRP

Electrotherapy

- Means the use of electrical currents for the treatment of
  - Acute and chronic pain
  - Muscle atrophy
- Different currents are used
  - Low-frequency (e.g., TENS)
  - Medium frequency

Terminology

- American Physical Therapy Assoc.
  - NMES – neuromuscular electrical stimulation
  - Stimulation of a target muscle or tissue via an intact nerve
  - TENS – transcutaneous electrical neural stimulation
    - A form of NMES – pain
  - EMS – Electrical muscle stimulation
    - Direct stimulation of an enervated muscle

Scribonius Largus (ca. 30 bis 54 n. Chr.)
Current Types

- **Direct current**
  - Current flows continuously in one direction

- **Alternating current**
  - Current reverses its direction of flow at defined intervals

- **Pulsed current**
  - C. flows in pulses or bursts instead of a continuous flow commonly used in PT

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Pulse Parameter

- **Frequency**
  - Number of pulses/second (Hz)

- **Intensity**
  - Corresponds to the amplitude of a pulse

- **Pulse duration**
  - The width or duration of a pulse (ms)

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Biological effects 1

- **Motor response**
  - A normally innervated muscle responds to electrical stimulation according to the frequency:
    - Single pulse: single twitch
    - < 10 Hz: multiple twitches
    - 10 Hz: tetanic contraction (muscle contraction last longer than the duration of the pulse) -- increase of muscle strength
    - 20 – 80 Hz: increase muscle tone
    - > 100 Hz: rapid fatigue of the neuromuscular system
    - 1 – 100 kHz: Nerves can not be stimulated at these frequencies
    - 2,500 Hz: Widely used for muscle strengthening

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**Important!**

- Although 20 – 80 Hz are used do increase muscle tone
- The resulting muscle contraction is not a physiological muscle work
- Use low frequencies together with active exercises
- Russian type provokes a more physiological response

**Biological effects 2**

- **Hyperaemia**
  - is due to
    - Muscle work - functional hyperaemia
    - Release of endogenous vasodilators - dilatation of the arterioles

- **Analgesia**
  - Gate control theory
  - Reduction of muscle tone
  - Stimulation of blood flow
  - Endogenous endorphin release
Indications

- Pain management
  - Osteoarthritis
  - Spondylosis, spondylarthrosis
  - After orthopedic surgery
- Muscle tension
- Prevention of muscle atrophy

Precautions/Contraindications

- Causal treatment of pain (underlying disease)
- Anesthetized areas of skin
- Acute inflammation
- Tumours
- Infectious diseases
TENS

Transcutaneous Electrical Nerve Stimulation

Is used in PT for
- orthopedic and neurological disorders
- especially if acute or chronic pain is present
- to treat or prevent muscle atrophy

Indications

- Pain management
  - Osteoarthritis
  - Spondylosis, spondylarthrosis
  - After orthopedic surgery
- Muscle tension
- Prevention of muscle atrophy
  - Always in combination with motion exercises

Precautions/Contraindications

- Causal treatment of pain (underlying disease)
- Anesthetized areas of skin
- Acute inflammation
- Tumours
- Infectious diseases
Operating Methods

High frequency – low intensity
- Relatively low, sensitive threshold doses
- Relatively high frequencies (50-150 Hz)
- Mechanism: Gate control system
- Intensity is increased until the patient feels a tingling sensation
- No pain or muscle contractions should be induced

Operating Methods

High intensity – low frequency
- Pulses of approx. 0.2 ms
- 2-4 Hz frequency
- Mostly for acupuncture points
- Intensity: visible muscle contractions
- Mechanism: endogenous endorphins

Operating Methods

BURST – TENS
- Bursts of pulses: 1-5 times a second
- Frequency: 40-150 Hz
- Higher intensity than that of high frequency/low intensity TENS
Operating Methods

Modulated TENS
- Automatic variation of pulse duration, frequency and amplitude
- Prevents accommodation

Technique 1

- Electrode placement
  - Local
  - Segmental
  - Over acupuncture points
  - Over trigger points

Local

- Along the edges of the painful area
- Over the most painful point
- Medial and lateral of joints

  Indications
  - Chronic disorders

  Precautions
  - Implants
  - Acute inflammation
  - Skin diseases
Local - Joints

Local - Spine

Segmental

- Electrodes are placed over the nerve root of the corresponding spinal segment

- Indications
  - Acute conditions
  - Multiple joint involvement
  - Implants
Segmental

Muscles

Over the motor point and over the muscle insertion

Patient preparation

- Comfortable position
- Soft and comfortable surface
- Application of heat before electrical stimulation is useful
  - Not in acute conditions!
### Electrode placement

- Rubber electrodes or gel pads
  - Clip hair carefully – avoid skin damage
  - Suitable contact gel – ultrasound gel
  - Spread an even layer of gel on the electrodes
- E-Pads – needle electrodes
  - No necessary of hair clipping
  - Wet the skin with water or alcohol – spray bottle
  - Slide the E-pad into the hair against the direction of hair growth
- Only wet/gel the area were the electrodes are placed!

### Treatment procedure

- Use of modulation is recommended
- Start with sinusoidal current – well tolerated
- Increase intensity slowly

### Technique 2

- **Dosage – generally**
  - Acute conditions
    - Low intensity
    - Short treatment duration
    - Short series of treatment
    - Short interval between treatments
  - Chronic conditions
    - Higher intensity
    - Longer treatment duration
    - Longer series of treatments
    - Longer intervals between treatment

- Only wet/gel the area were the electrodes are placed!
Technique 3

- Dosage according to the animals subjective criteria
  - Low dose: just below the sensory response
  - Medium dose: dog will notice a pricking sensation (relaxed, eyes closed)
  - High dose: normally not tolerated

Technique 4

- Dosage according to motor criteria
  - Below motor threshold: no visible twitch contraction
  - At motor threshold: Visible twitch contraction
  - Above motor threshold: Wavelike muscle movements and contractions

Treatment mode - Indication

- Acute
  - Segmentally
- Chronic
  - Joints: locally
    - Distal joints: Electrodes medial & lateral
    - Proximal joints: above & below
  - Spinal muscles
    - Transverse: left & right of the spine
    - Longitudinal: cranial & caudal
- Single joint:
  - Affected joint & areas of referred pain
- Multiple joints:
  - Initially most affected joint
Can we treat cats?

- Yes (mostly)

Home treatment

- Some TENS units are suitable for home treatment
- Instruct the owner carefully
- Perform the first treatments in your clinic
- Explain the owner how to use the unit
- Last session is performed by the owner under supervision
- Monitor regularly

Middle Frequency

- 1,000 to 100,000 Hz
- To currents with different frequencies are combined
- Mostly used: Russian
- No nerve stimulation
- Physiological muscle contraction
Iontophoresis

The use of continuous direct current to enhance the transdermal administration of a drug.

The drug will either be positive or negative in charge. If negative, it is placed under the cathode or negative electrode to repel the charges and “push” the drug in.

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Iontophoresis

- There are only a few studies which show an increase of the drug concentration in the tissue or the blood
  - American Journal of Sports Medicine by A. Burke Gurney, PT and Daniel C. Wascher (Dexamethason)

- Some “randomized, double-blind, placebo-controlled” Studies, showing a pain reduction /improved function

- The FDA confirms the iontophoresis as useful, to applicate Lidocain Fentanyl

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Iontophoresis

**Positive**
- Novocain
- Procain

**Negative**
- Mobilat
- Diclofenac
Iontophorese

**Electrode placement**

- Active Electrode directly on the targeted area
- Second electrode can be placed on each suitable position

**Dosage**

Dosage is given for an individual drug (e.g., 40 mA = min for dexamethasone)

Amplitude times time = current dosage

- At 1 mA the treatment time would be 40 minutes (40/1 mA = 40 min)
- At 4 mA the treatment time would be 10 minutes (40/4 mA = 10 min)
- Some evidence that more medication is delivered with a higher amplitude, lower treatment time

But as higher the dosage as higher is the risk of skin damage and destruction of the drug

- Use maximal (0.1) 0.2 mA/cm² electrode
- 5 cm² electrode = 5 x 0.2 = 1 mA