Biofeedback

Information provided from some measuring instrument about a specific biologic function
Biofeedback

- What do you do when you want to know how you look in the morning?
Biofeedback

- What do you do when you want to know how much you weigh?
Biofeedback

- What do you do when you want to know what your temperature is?
Biofeedback

- What do you do when you want to know what your blood pressure is?
Electromyographic (EMG) Biofeedback

- The use of electronic or electrochemical instruments to accurately measure, process, and feedback reinforcing information via auditory or visual signals.
Electromyographic (EMG) Biofeedback

- To help the patient develop greater voluntary control in terms of either neuromuscular relaxation or muscle re-education following injury

Muscle relaxation can be a learned response, not that these puppies need to learn how to relax any more!
Electromyography

- A clinical technique that involved recording of the electrical activity generated in a muscle for diagnostic purposes.
  - Uses either surface or needle electrodes for measuring electrical activity in the muscle and nerve conduction
Electromyography

- Electromyogram - Nerve Conduction Study
  - Graphic representation of those electrical currents associated with muscle action
The Role of Biofeedback

- "Biofeedback" can be looked at as a form of coaching.
  - Providing the patient with information so that he/she can make small changes in performance that are immediately rewarded and noted, ultimately leading toward improved functional outcomes.
Biofeedback Instrumentation

- Designed to monitor some physiologic event, objectively quantify these readings, and then interpret the measurements as meaningful information.

- The biofeedback equipment is designed to record some aspect that is highly correlated with the physiologic event.
Biofeedback

- Instruments can be used to measure:
  - Peripheral skin temperature
  - Finger photo-transmission
  - Skin conductance activity
  - Electromagnetic activity
  - Other applications
There are other types of biofeedback equipment available also that include:
- Electroencephalographs (EEGs)
- Electrogoniometers
Peripheral Skin Temperature

- This is an indirect measure of the diameter of peripheral blood vessels.
- As vessels dilate, more warm blood is delivered to a particular area, thus increasing the temperature in that area.
Peripheral Skin Temperature

- This effect is easily seen in the fingers and toes where the surrounding tissue warms and cools rapidly.
  - Associated with affective states
    - Decreases with response to fear or stress
Skin Conductance Activity

- Sweat Gland activity can be indirectly measured by determining electro-dermal activity, most commonly referred to as the “galvanic skin response.”
  - Sweat contains salt that increases electrical conductivity.
  - Sweaty skin is more conductive than dry skin.
Skin Conductance Activity

- **Instrumentation:**
  - Applies a very small amount of voltage across the skin, usually on the palmar surface of the hand or the volar surface of the fingers where there are a lot of sweat glands, and measures the impedance of the electrical current in micro(\(\mu\))-ohm units.
Skin Conductance Activity

- Measuring skin conductance is a technique useful in objectively assessing psychophysiological arousal and is most often used in “lie detector” testing.
Electromyographic Biofeedback

- The most commonly utilized form of biofeedback in the clinical setting.
  - EMG Biofeedback
Review of a Muscle Contraction

- Synchronous contraction of individual muscle fibers that make up the muscle
  - Muscle fibers are innervated by nerves that collectively comprise a motor unit
Review of a Muscle Contraction

- The axon of the motor unit conducts an action potential to the neuromuscular junction where a neurotransmitter is released.
As the neurotransmitter binds to receptor sites on the sarcolemma, depolarization of that muscle fiber occurs, moving in both directions along the muscle fiber.
Muscle Contraction

Skeletal muscle, also called striated muscle tissue, is made up of a series of sarcomeres.

A sarcomere consists of myosin and actin filaments which overlap upon contraction.

Myosin bonds with actin to ratchet the tropomyosin down the length of the myosin.
Electromyography of Muscle Contraction

- Creating movement of ions and thus an electrochemical gradient around the muscle fiber
  - Changes in potential difference or voltage associated with depolarization can be detected by an electrode placed in close proximity.
Motor Unit Recruitment

- The amount of tension developed in a muscle is determined by the number of active motor units.
- As more motor units are recruited and the frequency of discharges increased, muscle tension increases.
- Motor units are recruited based on the force required in an activity and not on the type of contraction performed.
Biofeedback is used to determine the muscle activity.
- It does not measure the muscle contraction directly.
- It measures the electrical activity associated with the muscle contraction.
Biofeedback Equipment & Treatment Techniques

- Indications
  - Regaining neuromuscular control
  - Increasing isometric and isotonic strength of a muscle
  - Decreasing muscle guarding
  - Improving pain reduction
  - Improving the psychological relaxation response
Biofeedback Equipment & Treatment Techniques

- Contraindications
  - Any musculoskeletal condition in which a muscular contraction might increase the symptoms of that condition or would be contraindicated
Biofeedback Equipment & Treatment Techniques

- Electrodes
  - The size of the electrodes will have no impact on the amplitude of the signal.
  - The size of the electrodes should be appropriate for the size of the treatment area and ranges from 4mm to 12.5mm for larger muscles.

- Conductive Interface
  - Regardless of the size or type of electrodes, there needs to be a highly conductive gel, paste or cream in between the electrode and the patient’s skin.
Biofeedback Equipment & Treatment Techniques

- Skin Preparation
  - Remove oils, dead skin and excessive hair to help reduce impedance
  - Cleaning with an alcohol pad may help reduce oils and the presence of dirt, thus helping with conduction
Biofeedback Equipment & Treatment Techniques

- Electrode Placement
  - As close to the muscle being monitored as possible
  - Parallel to the direction of muscle fibers to ensure that a better sample of muscle activity is monitored
Biofeedback Equipment & Treatment Techniques

- Visual Feedback
  - There are a variety of options that are dependent upon the manufacturer of the device
    - Selection will be dependent upon the preference of the patient
      - Line traveling across an oscilloscope
      - Light or series of lights that go on and off
      - A bar graph that changes dimension in response to the incoming information
  - Video games
  - Meters
    - Analog with a needle
    - Digital with numbers
Biofeedback Equipment & Treatment Techniques

- Audio Feedback
  - Dependent upon the manufacturer
  - Selection for a patient is dependent upon the preference of the patient
    - A tone
    - Buzzing
    - Beeping
    - Clicking
    - An increase in the pitch of a tone, buzz, or beep, or an increase in the frequency of clicking indicates an increase in the level of electrical activity
    - Conversely, decreases indicate a decrease in the level of electrical activity
Biofeedback Equipment
Clinical Applications for Biofeedback

- Muscle re-education
  - Regaining neuromuscular control and increasing muscle strength
    - Hemiplegia following CVA
    - Spinal cord injury
    - Spasticity
    - Cerebral palsy
    - Facial paralysis
    - Urinary and fecal incontinence
- Relaxation of muscle guarding
- Pain reduction