Introduction to Biofeedback

- Monitoring of specific physiological responses
- Immediate visual, auditory, or tactile representation of the physiological function
- Enhanced sensory information
- Physiological control

Therapeutic Relationship in Biofeedback

- Biological control
- Internal and self actuated
- Coaching-strategies
- Passive volition
- Unconscious learning

Advantages for Clients

- Poor psychologically minded
- Cost effective (avoidance of surgery/drugs)
- Enhanced sensory awareness
- Increased self awareness
- Mind-body awareness
- Increased self-efficacy and confidence
- Generalization of self-regulation

Advantages for Therapist

- Assessment and treatment planning aid
- Objective measurement through treatment
- Gives immediate feedback for success

Therapists use sEMG to:

- UPTRAIN – facilitate weak muscles
- DOWNTRAIN – inhibit tense or hypertonic muscles
- RE-EDUCATE – coordinate muscle activity between agonists, antagonists, and synergists
The primary reason for monitoring two surface EMG tracings during a pelvic floor muscle assessment is to determine whether or not the patient can produce an isolated pelvic floor muscle contraction.

- sEMG gives feedback on muscles and assesses timing of contraction and relaxation
- It does NOT measure strength

Tasks of an EMG Machine
- Receive the very small amount of electrical energy from the skin.
- Separate EMG energy from other extraneous energy on the skin, and to greatly magnify the EMG energy.
- To convert this amplified EMG energy into feedback/info that is meaningful to the patient

The EMG Instrument
- Picks up weak electrical signals generated during muscle action.
- Each muscle consists of motor neurons electrically connected to higher levels of the nervous system.
- Muscle contraction occurs when these motor neurons carry electrical signals to muscle fibers.
- A small part of energy leaves the muscle and migrates through surrounding tissue.
- Some of this electrical energy becomes available to monitor at the surface of the skin.

EMG Instrument
- sEMG gives feedback on muscles and assesses timing of contraction and relaxation
- It does NOT measure strength

Surface EMG
- Does not directly monitor the muscle contraction, but monitors an electrical aspect of muscle contraction that bears a relationship to muscle contraction.
- EMG measures an electrical correlate of muscle contraction and reads out in electrical units (microvolts – millionths of a volt).
sEMG Limitations

- Data interpretation
- Not sure if there is muscle fatigue
- Hard to isolate one muscle without carryover or “help” from another muscle (adductors with PF)
- Session to session consistency
- Microvolt quantification standards

Skin Preparation

- A standard part of electrode application is to remove oil, dead skin, dirt, makeup, and lotion. These impede the travel of bioelectric signals from the skin to the electrode.
- Surface electrodes contact the skin through an electrically conductive cream or gel.

Measuring Muscle Contraction

- A biofeedback device cannot measure muscle contraction in a direct way. The muscle is inaccessible, so biofeedback exploits the electrical aspect of the muscle contraction.

Muscle Contraction and Muscle Fibers

- Muscle contraction results from the synchronous contraction of the many muscle fibers that make up a muscle.
- Muscle fibers are actuated by electrical signals carried by cells called “motor units,” and the contraction corresponds to the collection of electrical activity in the muscle fibers.

Electrical Activity

- Is sensed with surface electrodes that contact the skin above the muscle, where there exist weakened electrical signal from muscle fibers beneath the skin.

Artifact

- Anything you don’t intend to measure in the sEMG signal.
- Examples: volume conductance from other muscle, heart rate, 60 Hz electricity, electrode impedance problems, radio frequencies, respiration, static
### Symptoms of Artifacts
- Feedback display is erratic
- High frequency patterns in raw data: evidence of electrostatic problems
- Continuous signals between 45 and 90 Hz could be heart rate
- Body movement and sweat appear as low frequencies in raw data
- Electrical bridge between electrodes (conduction gel is smeared) = low readings
- Faulty electrode contact = high readings

### Correcting Artifacts
- Check to see if everything is plugged in correctly
- Clean and reapply electrodes
- Use 60 Hz notch filter to remove electrical interference
- If static is detected:
  - Reboot software
  - Use band pass filters

### Amplitude Norms
- No research norms exist for sEMG of the pelvic floor muscles
- Cram’s (1983) research provided a benchmark with a goal of creating equivalent resting values for practitioners and manufacturers
- Created the source for using 2 microvolts for a baseline resting reading

### EMG Sensor Placement Principles
- Skin preparation for low impedance
- The closer the two active electrodes the more specific and shallow the source of EMG signal
- Electrode site selection
  - specific or general
  - right and left upper trapezius 2 channels (specific)
  - one channel right and left upper trap (general)
  - wrist to wrist and ankle to ankle (general)
  - vaginal or rectal (specific)
- Electrode sensor sizes and types

### Internal Surface EMG Sensors
- Rectal Sensors
- Vaginal Sensors

### Vaginal, Rectal, Surface Electrodes
- Thought Technology, Inc.
External sEMG Electrodes

External Placement

Reference: Beth Shelly

EMG Assessment Considerations
- Posture
- Adipose tissue (side lying recommended)
- Volume conduction (electrodes not in direct contact with the muscle)
- Age and gender
- Protocols
  - Stress profile
  - Static and dynamic
  - Asymmetrical & symmetrical
  - Muscle isolation

Biofeedback Techniques
- 3 Clinical Entities
  - Downtraining
  - Uptraining (turning on a muscle that is weak)
  - Coordination Training (obtain the correct balance of agonists and antagonists)

Downtraining
- Defined as decreasing the activity of a tense muscle
  - Verbal cues
  - Breathing
  - Imagery
  - Autogenics
  - Muscle Discrimination (ramp up/down)
  - Antagonist activation
  - Positioning

Feedback and Control
- Essential features
  - Accuracy
  - Fast
  - Meaningful to client
EMG Biofeedback Assessment and Treatment

- PFM and abdominal EMG testing
- Assess resting tone, slow and fast-twitch muscle fibers in 3 positions, and valsava maneuver in sitting
- Down-train PFM hypertonus
- Coordination training
- Strength and endurance training

Treatment Strategies/Options

- Plan of care
- Surface EMG biofeedback to down train and/or up train
- Pain management
- Behavior modification
- Patient education
- Trigger point therapy
- Manual/passive stretch/myofascial release

Treatment Strategies Continued

- Modalities – Heat/cold
  - Ultrasound
  - TENS
  - Interferential
  - Electrical stimulation
- Long term management
- Posture management

Behavioral Therapy

- Prompted or Scheduled Toiletting
- Bowel & Bladder Retraining
- Dietary & Fluid Modifications
- PFM Re-education
- Habit Training

What Makes a Case Complex?

- Multiple symptoms
- Conflicting symptoms
- Poor muscle awareness
- Presence of scar tissue
- Other medical/social issues that may interfere with treatment or learning
Pelvic floor muscle hypertonus (pre and post elevated readings) weak contractions with abdominal substitution (pelvic floor myalgia)

Good relaxation of pelvic floor muscles with bearing down

Co-contraction of pelvic floor and abdominal muscles when attempting to bear down (pelvic floor dysynergia, constipation, urinary frequency and hesitancy)

Relaxation Techniques

- Progressive relaxation (tense/relax)—Edmond Jacobson
- Autogenic training (self-suggestion—e.g., hand warming, depth of breathing, or heart rate)
- Hypnosis and self-hypnosis
- Guided imagery
- Meditation
- Diaphragmatic breathing and paced respiration
- Quick relaxation exercises
- Cognitive interventions
- Generalization—integrating relaxation into daily life
- Thought stopping
- Mindfulness, being in the moment
- Identifying feelings of calmness and accessing them at will
- Ability to self soothe
CASE STUDIES

- **Stress Incontinence** - Lois is a seventy-two year old woman, mother of three. For two years now she has been experiencing mild leaking with sneezing and coughing.

- **Urge Incontinence** - Grace is fifty-seven years old, and works in the front office of a busy travel agency. She is so busy that she will rarely use the toilet while at work. When she does go to the bathroom, she notices that she leaks before she can get to the toilet, often soaking her underwear.

- **Fecal Incontinence** - Lauren is sixty-three and lives alone. Lauren has noticed that her bowel movements are unpredictable. Last month she was out shopping when she had the urge to move her bowels and she could not find a rest room in time, causing her to leak stool.

STRESS UI CASE STUDY

Lois is a seventy-two year old woman, mother of three. For two years now she has been experiencing mild leaking with sneezing and coughing.

Stress Urinary Incontinence Treatment

Complaint of involuntary leakage on effort or exertion or with sneezing or coughing.

Treatment options

- Voiding Diaries/Discuss dietary irritants
- Education regarding role of pelvic floor musculature and continence
- Pelvic floor muscle strengthening with or without EMG biofeedback
- Electrical stimulation if pronounced weakness or lack of proprioception
- KNACK

Urge UI Case Study

Grace is fifty-seven years old, and works in the front office of a busy travel agency. She is so busy that she will rarely use the toilet while at work. When she does go to the bathroom, she notices that she leaks before she can get to the toilet, often soaking her underwear.
Urge Incontinence Treatment

- The urgent need to pass urine and the inability to get to a toilet in time.

**Treatment Options:**

- Education: use of pelvic floor muscles to inhibit detrusor activity and other inhibition techniques
- Pelvic floor muscle strengthening with or without EMG biofeedback
- Neuromuscular relaxation with or without biofeedback
- Dietary counseling regarding bladder irritants and fluids
- Bladder retraining
- Electrical stimulation

Fecal UI Case Study

Lauren is sixty-three and lives alone. Lauren has noticed that her bowel movements are unpredictable. Last month she was out shopping when she had the urge to move her bowels and she could not find a rest room in time, causing her to leak stool.
Biofeedback for Fecal Incontinence

Used to improve or compensate for:
- PFM/EAS weakness, incoordination, poor endurance, poor rectal support
- Paradoxical contraction (failure to relax)
- Ability to use abdominals correctly to increase abdominal pressure for strain-free evacuation
- Sensory deficits

Source: Jeannette Tries, OT

Biofeedback Goals for FI Treatment

- Improve selective PFM contraction
- Decrease long-latency to relax after contraction
- Decrease baseline activity
- Decrease paradoxical EAS activity with evacuation maneuvers
- Instruct in bowel management (diet, fluids, gastro colic reflex)
- Establish a HEP

Source: Jeannette Tries, OT

Overactive PF – Pre Tx

Overactive PF – Post Tx

PFM EMG Down-training

- The goal is to improve stability
- Improve voiding mechanics
- Increase awareness and proprioception
- Quieting muscle spasm
- Decrease electrical output of muscle
- Improve muscle discrimination
- Need to down-train before you up-train!

Relaxation

- Try to have patient correlate sEMG signal with movement
  - Ask, “Did you FEEL that?”
  - “Can you feel what you see?”
  - “Can you feel the tension release?”
  - Use below tone goal to reward success
  - Takes persistence, patience, and commitment for patient to detect small changes

Source: Jeannette Tries, OT
Treatment Strategies for Overactive PF

- Surface EMG biofeedback to down-train and/or up-train
- Pain management
- Behavior modification
- Patient education including pelvic floor exercise program
- Trigger point therapy
- Manual/passive stretch/myofascial release

Chronic Constipation - Pre Tx

How to Get BCIA Board Certified

- Must be licensed as a RN, PA, MD, OT, PT
- PTAs and COTAs may be a board certified technician
- 24 hours of didactic education + 4 hours practicum
- 18 hours of mentoring
- Written certification exam
- Recertified every 3 years with 36 hours accredited PMD CEUs

Resources for Training & Continuing Education

- Society for Urologic Nurses and Associates
  1-888-TAP-SUNA  www.suna.org
  - Annual spring symposium related to incontinence and pelvic floor disorders (multi-disciplinary)

- Biofeedback Foundation of Europe
  Tel/Fax +31 84 83 48 696 or www.bfe.org
  - Offers on-line didactic and practicum training toward certification