The Use of High-Voltage Pulsed Current for Treating Secondary Lymphedema

Mary Calys, PT, DPT, CLT, CKTP
Gabriela Montero, BS
Lisa VanHoose, PT, PhD, CLT-LANA, CKTP

Learning Objectives

1. Describe the biochemical and physiologic effects of various therapeutic modalities for the treatment of lymphatic failures.

2. Formulate evidence-based therapeutic interventions integrating physical modalities for patients with secondary lymphedema and other edemas.

3. Discuss defensible documentation and functional limitation reporting for edema-focused plans of care.

4. Demonstrate the use of various therapeutic modalities with simulated patient scenarios.

Outline

• History of physical agent use in physical therapy
• Description of Secondary Lymphedema
  – Use of physical agents
• Low level LASER
• HVPC
• Ultrasound
• Kinesiology taping

Learning Objectives

1. Describe the biochemical and physiologic effects of various therapeutic modalities for the treatment of lymphatic failures.

2. Formulate evidence-based therapeutic interventions integrating physical modalities for patients with secondary lymphedema and other edemas.

History of Therapeutic Modalities

• Low Level Laser Therapy was cleared by the Food and Drug Administration in 2002
  – Premarket Notification/510(k)
  – Initially for pain

• Biostimulation laser

http://www.fda.gov/Radiation-EmittingProducts/ResourcesForYou/RadiationEmittingProducts/cr252761.htm
• FDA-listed medical devices
• 510(k) exempt medical devices
• Cleared medical devices
• Approved medical devices

• Center for Devices and Radiological Health
  — Jeffrey E. Shuren, M.D., J.D., Director

http://www.fda.gov/AboutFDA/Transparency/Basics/ucm194468.htm

History of Therapeutic Modalities

• Units became available in the 1940s
• “HVPC is a monophasic pulsed electric current that consists of double-peaked impulses (5-200 μs), at very high peak-current amplitude (2-2.5 A), and high voltage (up to 500 V), at a frequency of 1-125 pulses per second.” (Polak et al, 2014)

FDA and Electrical Stimulation

• “Electrical muscle stimulators are considered devices under the Federal Food, Drug, and Cosmetic Act. ... Most electrical muscle stimulators (EMS devices) that have been reviewed by FDA are intended for use in physical therapy and rehabilitation under the direction of a health care professional.”

• “The FDA has cleared many electrical muscle stimulators for prescription use in treating medical conditions. Doctors may use electrical muscle stimulators for patients who require muscle re-education, relaxation of muscle spasms, increased range of motion, prevention of muscle atrophy, and for treating other medical conditions which usually result from a stroke, a serious injury, or major surgery. Again, the effect of using these devices is primarily to help a patient recover from impaired muscle function due to a medical condition, not to increase muscle size enough to affect appearance.”

Yakut & Kirdi Study

• 80 healthy subjects
• 4 groups (n=20)
• Trained 10 mins, 5 days/wk for 3 weeks
• Outcome Measures
  – Quadriceps femoris muscle strength
  – Pain perception (VAS)
  – Current intensity tolerance
• HVPGS or HVPC best outcomes for pain and strengthening

Turkish Journal of Physiotherapy Rehabilitation, 01 April 2001

History of Therapeutic Modalities

• FDA has not approved any electrical stimulation device for the treatment of chronic wounds
  — European Pressure Ulcer Advisory Panel and National Pressure Ulcer Advisory Panel, 2009 (Strength of Evidence A)
  — Consortium for Spinal Cord Medicine (Strength of Evidence A and Strength of Panel Opinion — Strong)
  — National Institute for Health and Care Excellence (NICE) recommended that electrical stimulation not be used as an adjunctive therapy
History of Therapeutic Modalities

- **1980s and 1990s** researchers began to investigate the impact of HVPC on edema
  - Animal
    - Bettany et al 1990
    - Mendel et al 1992
    - Thornton et al 1998
  - Humans
    - Straka et al 1998
    - Michlovitz et al 1998
    - Griffin et al 1990
  - Negative polarity
  - Mixed conclusion
    - Possible benefits for acute swelling

- **In 1920s and 1930s**, ultrasound was used for sports medicine physical therapy (Orenstein 2008)
  - Used to treat all types of ailments
    - Arthritic pains
    - Gastric ulcers
    - Eczema
    - Asthma
    - Hemorrhoids
    - Urinary incontinence
    - Angina pectoris
    - Elephantiasis

History of Therapeutic Modalities

**Learning Objectives**

1. Describe the biochemical and physiologic effects of various therapeutic modalities for the treatment of lymphatic failures.

2. Formulate evidence-based therapeutic interventions integrating physical modalities for patients with secondary lymphedema and other edemas.

3. Discuss defensible documentation and functional limitation reporting for edema-focused plans of care.
Lymphedema

“Chronic disorder characterized by the abnormal accumulation of lymph fluid in the tissues of one or more body regions”

O’Sullivan 2007

Secondary Lymphedema

- Most prevalent lymphedema
- Diagnosed after at least 3 months of chronic edema
- Multiple causes
  - Filariasis - #1 International
  - Surgery
  - Infection
  - CVI
  - Trauma
  - Radiation
  - Obesity
  - Cancer and its treatment - #1 USA
  - and other causes......

Epidemiology of Chronic Edemas

- Chronic edema can affect persons from various populations
  - Obesity
    - Five-year retrospective review (2000–2005) showed that 75% of morbidly obese patients had lymphedema. (Fife, 2009, 2)

- Cardiovascular Disease
  - Heart disease
    - Relationship between edema, myocardial fibrosis, and cardiac dysfunction has been reported in human and animal studies. (Bangor, 2010 and Kong, 2006)
  - Stroke
    - 57% of the post stroke patients had swelling of the paretic hand. (Leibovitz et al, 2007, 37)
  - Peripheral vascular disease
    - 80% of patients with occlusive peripheral arterial disease (Salzler, 1993, 17)
  - Chronic venous disease
    - Advanced disease is associated with edema (Eklof et al, 2004, 1248)

- Cancer
  - Lymphedema resulting from events, abnormalities or disease from outside the tissues of the lymph system such as cancer treatment
  - Up to 26% in melanoma populations (Browse, 2003)
  - Up to 31% in cervical cancer populations (Houck et al, 2002, 1284)
  - Up to 18% in uterine cancer populations (Ryan et al, 2003, 148)
  - Up to 13% in prostate cancer populations (Amdur, 1990, 235)

Impact of Edema on Health Outcomes

- Obesity
  - Increased infections and antibiotic use (Fife, 2009, 2)

- Cardiovascular
  - Traumatic brain edema increases damage and described as cellular edema (Murrow, 2004, 5a)
  - Heart transplant rejection is characterized by myocardial edema during the early stages of recovery (Chandrasekaran et al, 1987, 1)
  - Edema has been associated with diabetic neuropathy (Johnsson, 1985), macular disease (Wilkinson, 2003), and nephropathy (Harmel, 1990).

Adapted from Fife 2009

Lymphatic Failure

- Dynamic (edema)
  - Transport capacity = normal
  - Lymphatic load = increased

- Mechanical (lymphedema)
  - Transport capacity = decreased
  - Lymphatic load = normal

- Combination (lymphedema)
  - Transport capacity = decreased
  - Lymphatic load = increased

- Hemodynamic (cardiac edema)
  - Transport capacity = normal/decreased
  - Lymphatic load = increased due to right ventricular failure

Lymphedema

- Unilateral, normally
- Asymmetrical
- Firm edema
- Pitting – Stage 1 only
- Foot involved
- Frequent cellulitis
- Pale skin color
- Stemmers positive, normally
- Ulcerations
- Progressive, lifelong disease without treatment
Treatment

ACUTE

RICE

Short-term compression

Massage

Within 24hr – 1 week

Dynamic failure

CHRONIC

Self MLD QID–QH+ & Clinical MLD

Lifelong compression garments

Manual lymph drainage

1 week – 3months

“Watchful waiting”

Surgical edema

> 3 months

Mechanical or combined failure

Criteria for identifying LE were used:

- 2cm circumferential change at any measured location
- 200ml perometry LVC of the affected arm
  - Water displacement
- 10% perometry LVC of the affected arm
  - 5%
  - 3% (Stout et al, 2012)
- Body weight adjusted
- Self-report of limb heaviness and swelling, either ‘now’ or ‘in the past year.’

Arner et al 2005-2011

International Society of Lymphology Staging

- Stage 0
  - Brief swelling in hand
  - Subclinical
    - 2% volume change

- Stage 1 (Reversible)
  - Edema
  - Soft
  - Pitting
  - No pain
  - 2-cm or greater difference in limb girth, a 200-ml or greater difference in limb volume, or a 10% or greater difference in limb volume

- Stage 2 (Spontaneously Irreversible)
  - Edema
  - Fibrotic changes difficult to pit
  - Measure with tonometer
  - Can reduce edema to normal
  - Can soften filaments, but not reverse fibrosis
  - May have pain

- Stage 3 (Irreversible)
  - Severe edema
  - Fibrosis
  - No pitting too much fibrosis
  - Pain and skin discoloration

Documentation and Billing

- Policy
  - Medical Local Coverage Determination
  - Conservative treatment considerations

- Billing
  - Used the appropriate CPT
    - Kinesiotaping (why are you using it 97110, 97140, 97112)
    - Don’t use strapping codes with kinesiotaping
    - Attended vs unattended electrical stimulation

- Documentation
  - Outcome measures (functional and self-report)
  - Photos
    - Placement of electrodes, tape, etc
  - Target nerve (electrical stimulation)
  - Blocks (kinesiotaping)
  - Patient or caregiver education (97535)

Learning Objectives

1. Describe the biochemical and physiologic effects of various therapeutic modalities for the treatment of lymphatic failures.

2. Formulate evidence-based therapeutic interventions integrating physical modalities for patients with secondary lymphedema and other edemas.

3. Discuss defensible documentation and functional limitation reporting for edema-focused plans of care.

4. Demonstrate the use of various therapeutic modalities with simulated patient scenarios.

LOW LEVEL LASER THERAPY
Clinical Applications

• Largely unknown
• Pain
• Wound Healing/Scar
• Immunological response
• Connective tissue stimulation (bone)

What happens to light when it hits an object?

• Absorbed
• Reflected
• Transmitted
• Refracted

Light Amplification of Stimulated Emissions of Radiation

• Coherence – same wavelength and in phase
• Monochromacity – same color (same as wavelength)
• Collimation – in parallel (minimal divergence)

Wavelength

Radiation Wavelengths
<table>
<thead>
<tr>
<th>Laser Type</th>
<th>Wavelength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argon Fluoride (UV)</td>
<td>193 nm</td>
</tr>
<tr>
<td>Krypton Fluoride (UV)</td>
<td>248 nm</td>
</tr>
<tr>
<td>Nitrogen (UV)</td>
<td>337</td>
</tr>
<tr>
<td>Argon (blue)</td>
<td>488</td>
</tr>
<tr>
<td>Argon (green)</td>
<td>514</td>
</tr>
<tr>
<td>Helium neon (green)</td>
<td>543</td>
</tr>
<tr>
<td>Helium neon (red)</td>
<td>633</td>
</tr>
<tr>
<td>Rhodamine 6G dye (tunable)</td>
<td>570-650</td>
</tr>
<tr>
<td>Ruby (CrAlO3) (red)</td>
<td>694</td>
</tr>
<tr>
<td>Gallium Arsenide (GaAs) (NIR)</td>
<td>850</td>
</tr>
<tr>
<td>ND:Yag (NIR)</td>
<td>1064</td>
</tr>
<tr>
<td>Carbon Dioxide (FIR)</td>
<td>10,600</td>
</tr>
</tbody>
</table>

Publications explaining physiological response to light therapy

Light may activate enzymes catalyzing biological pathways. It will be necessary to find the specific wavelength that will activate the chosen enzyme.

Kendric C. Smith, Stanford University School of Medicine

Early Studies on Physiological Responses

• Increased collagen production, Abergel et al., Laser conf. 1987.
• Increased phagocytosis, Mester et al., Am J. Surg. 122, 1971.

Methods of application

• Vary treatment time and pulse rate
• Device can have laser in hand or use fiber optics
• Cover area equally and in defined manner
• Keep light perpendicular to skin

Light Penetration

• Depth of penetration depends on the type of laser (wavelength)
• HeNe laser absorbed in first 2 – 5 mm
• GaAs laser absorbed in 1 - 2 cm
• IR lasers can penetrate up to 13 cm

Dosage

• What is a Joule?
  – 1 J = 1 W/sec
  – Energy density J/cm² (average power)
• Pulsed or continuous (at same output, more energy with continuous)
Dosage

• Dosage depends on
  – Output of the laser (W)
  – Exposure time (sec)
  – Surface area of the LASER beam (cm$^2$)

Dosage

• How to know how long to irradiate an area?
  \[ TA = \frac{E}{P} \times A \]
  \[ TA = \text{Treatment time for a given area (s)} \]
  \[ E = \text{Energy in J/cm}^2 \]
  \[ P = \text{Average power of the laser (W)} \]
  \[ A = \text{Beam area (cm}^2\text{)} \]

Application

• Grid system for application
  – Divide the tissue area by the area of the LASER beam.
  – Treat each grid area with the desired J.
  – Can be used when laser is in contact with skin or non-contact

Application

• Scanning Technique
  – Hold applicator 5-10 mm from skin
  – Non-contact method
  – More likely to measure total time for area

Application

• Pad Technique
Dosage

- 0.05 to 0.5 J/cm² for acute conditions
- 0.5 to 3.0 J/cm² for chronic conditions
- Superficial = HeNe
- More depth = GaAs
- Deeper = IR

Applications (direct versus indirect effects)

Wound healing
- Acute superficial  HeNe 0.5 – 1 J/cm²
- Chronic superficial  HeNe 4 J/cm²
- Acute deep  GaAs 0.05-0.1 J/cm²
- Chronic deep  GaAs 0.5-1 J/cm²
- Trigger point
  - Superficial  HeNe 1-3 J/cm²
  - Deep  GaAs 1-2 J/cm²
- Edema reduction
  - Acute  GaAs 0.1-0.2 J/cm²
  - Subacute  GaAs 0.2-0.5 J/cm²

LLLT and Edema Management

- Meta Analysis or Systematic Reviews
  - Pain and swelling in women with BCRL – moderate strength (Smoot et al, 2014)
  - Positive results for reducing swelling for upper limb lymphedema (Monteiro et al, 2014)
- RCTs
  - Facial swelling (Aras and Gungormus, 2009)
Case studies

HIGH VOLTAGE PULSED CURRENT

Clinical Applications
• Also called High Voltage Galvanic Stimulator

• Indications
  – Pain
  – Edema
  – Muscle weakness
  – Wound management

Physiological Response
• Works best for acute edema
  – Treat early
  – Results are mixed for acute and chronic edemas
  (Micolovitz 1988; Griffin 1990; Stralka et al 1998,
   Mendel 2010; Sandovol 2010)
• Slows new formation
• Electrostatic repulsion
  – Cathode repels negative charged proteins
• Decreases microvessel leakiness (Reed 1988)

Contraindications to HVPC
• over neoplastic regions
• heavy scarring
• thick adipose tissue
• extreme edema
• osteomyelitis
• anterior cervical area

• transthoracic region
• transcranial area
• pregnant: over lumbar and abdomen
• hemorrhagic area
• electronic implants

Parameters
Goal: Slow edema formation
Amplitude: to tolerance
Phase duration: 100 microseconds
  – 20-100
Frequency: 120 pps
Polarity: negative/cathode
Treatment time: 30-60 minutes,
Frequency: QD – BID
Mode: Continuous/no ramp
Parameters

- **Goal:** produce tetanic muscle contractions
- **Frequency:** arbitrary 30-60 pps
- **Mode:** pulsed, on/off 1-5 or 1-3
- **Amplitude:** arbitrary 1-500 V
- **Duration/width:** arbitrary 5-30 min

Application

- **Treatment should be 30-60 minutes**
- **Electrode type**
  - rubber carbon, electromesh glove/sock
- **Electrode arrangement**
  - Large dispersive electrode with:
    - one, two, or four active electrodes (bifurcated)
    - Handheld electrode
    - Equal size (if more than one active electrode)
- **Coupling media**
  - gel or saline soaked sponge
  - Conductive spray

Precautions

- **Chemical burn**
  - Excessive electrical density
    - Intensity too high for size of the active electrode
    - Direct metal contact

HVPC and Edema Management

- **Meta Analysis or Systematic Reviews**
  - Synder et al 2010
  - HVPC for edema management after acute injury
    - negative polarity
    - pulse frequency of 120 pulses/s
    - intensity of 90% visual motor contraction
    - four 30-min treatment sessions (30-min treatment, 30-min rest cycle for 4 h)
    - single, continuous 180-min session

Case studies

ULTRASOUND
INAUDIBLE, ACOUSTIC VIBRATIONS
OF HIGH FREQUENCY
THAT MAY PRODUCE
EITHER
THERMAL OR NONTHERMAL
PHYSIOLOGIC EFFECTS

The Objective of Ultrasound
To provide the lowest intensity of ultrasound energy at the highest frequency that will transmit the energy to a specific tissue and achieve desired therapeutic effect

Physiological Effects
- Thermal
  - Increase extensibility of collagen fibers
  - Decrease in joint stiffness
  - Reduction of muscle spasm
  - Modulation of pain
  - Increased blood flow
  - Mild inflammatory response to reduce chronic edema

Mechanisms for Achieving Thermal Effects
- Increase tissues to 40-45 degrees Celsius
- Increase tissues from baseline
- 1 degree: Increased metabolism/healing
- 2 to 3 degrees: Decreased pain/muscle spasm
- 4 degrees: Greater collagen extensibility and decreased joint stiffness

Depth of Penetration for Thermal Effects
- 1 MHz – deep tissues
- 3 MHz – depth of 2.5cm

Physiological Effect
- Nonthermal
  - Cavitation
    - Expansion and compression of gas-filled bubbles due to pressure changes
    - Stable
    - Unstable
  - Microstreaming
    - Unidirectional movement of fluids. Can produce changes in cell membrane permeability due to high viscous stresses
Contradictions:

- DVTs
- Decreased circulation
- Eye
- Reproductive organs
- Pregnancy
- Pacemaker
- Malignant tumor
- Growth plates
- Metal implants
- Decreased sensation

Procedures

- Plan treatment
  - Size of area
  - Intensity
  - Frequency
  - Temperature Change

Parameters

Soft tissue healing:
- Pulsed 0.5 W/cm² with duty cycle of 20% for 5 minutes
- Continuous 0.1 W/cm²

Pitting edema:
- Continuous 3 MHz at 1 - 1.5 W/cm²

Chronic Inflammation:
- 1.0 – 2.0 W/cm² at 20% duty cycle

Direct Application

- Apply gel to skin surface and transducer
- Turn machine on and set parameters
- Applicator should strike the surface at 90 degrees
- Move soundhead at 4 cm/sec

Immersion Technique

- Use for small or irregular areas
- Use a plastic, ceramic, or rubber basin
- Use tap water
- Move transducer parallel to surface at a distance 0.5 – 1 cm
- Intensity should be increased for adequate heating. (up to 50 percent)

Bladder Technique

- If immersion is not suitable
- Gel should be added to both sides of the balloon
Phonophoresis

Ultrasound is used to enhance delivery of selected medication into tissue

- Apply medication directly onto surface
- Do not mix medication and gel
- Apply gel for ultrasound treatment
- Can use direct or immersion technique
- Can use pulsed or continuous

Documentation

Record the specific parameters
- frequency
- spatial-averaged temporal peak intensity
- pulsed or continuous
- duty factor (if pulsed)
- ERA
- duration of treatment
- number of treatments per week
- patient response to treatment

Ex. Ultrasound to left anterior deltoid at 3 MHz, at 1.0 W/cm², pulsed at 20 percent (0.2) duty factor, 5 cm transducer head, 5 minutes, four times per week. Patient reported decrease in pain from 6/10 to 2/10. Upper extremity swelling decreased by 4% (3540 ml to 3400 ml)

Evidence

- Systematic Reviews
  - None
- RCTs
  - Placebo effect (Hashish et al 1988; Hashish et al 1986)
  - Balzarini study (1993)

Case studies

**KINESIOLOGY TAPING**
### Mechanical Correction

- 50-75% tension
- Inward/Downward pressure
- Positional stimulus to influence a desired resting position
- Maintains full, functional AROM
- Maintains circulation
- "Inhibits" Pathological movement

<table>
<thead>
<tr>
<th>Y Strip</th>
<th>Tension in the Tails - Low level of stimulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Strip</td>
<td>Tension in the Center of Base - High level of stimulus</td>
</tr>
</tbody>
</table>

### Fascia Correction

**"Oscillating Tissue"**
- 10 - 25% tension for Superficial Fascia
- 25 - 50% tension for Deep Fascia
- Oscillate tape "side to side" or "long and short" Oscillations applied throughout Therapeutic Zone
- Creates unwind or direct movement of fascia

**"Lifting"**
- 10 - 35% tension in center of tape
- Decrease pressure on target tissue
- Create recoil and lift over target tissue
- I Strip: 25 - 35% tension
- Donut Hole Cut: 15 - 25% tension
- Web Cut: 10 - 20% tension

### Space Correction

**"Lifting"**

<table>
<thead>
<tr>
<th>Ligament / Tendon Correction</th>
<th>Circulatory / Lymphatic Correction &quot;Channeling&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ligament:</strong> 75 - 100% tension</td>
<td>0 - 20% tension Anchor is typically applied proximally, near healthy patent lymph node. Directional pull of the tape allows the exudate to travel to less congested areas, through superficial lymphatic pathways. Fan tails over congested area.</td>
</tr>
<tr>
<td>No stretch on target tissue</td>
<td>Stretch target tissue Stimulate GTO for joint protection.</td>
</tr>
<tr>
<td>Primary support to injured tissue at joint. Perception of support through stimulation of mechanoreceptors.</td>
<td></td>
</tr>
<tr>
<td><strong>Tendon:</strong> 50 - 75% tension</td>
<td></td>
</tr>
<tr>
<td>Stretch target tissue</td>
<td></td>
</tr>
<tr>
<td>Stimulate GTO for joint protection.</td>
<td></td>
</tr>
</tbody>
</table>

### Ligament / Tendon Correction "Proprioceptive"

- 75 - 100% tension
- No stretch on target tissue
- Primary support to injured tissue at joint.
- Perception of support through stimulation of mechanoreceptors.
- **Tendon:** 50 - 75% tension
- Stretch target tissue
- Stimulate GTO for joint protection.

### Circulatory / Lymphatic Correction "Channeling"

- 0 - 20% tension
- Anchor is typically applied proximally, near healthy patent lymph node. Directional pull of the tape allows the exudate to travel to less congested areas, through superficial lymphatic pathways. Fan tails over congested area.

### Lymphatic flow

- **Fan strip**
  - Anchor at the point where lymphatic flow is to be directed
  - 15%-25% tension
  - Recoil effect will provide directional flow input
- **Jellyfish**
  - 2 strips, 4 or more tails
  - 0%-5% tension in center of tape
  - 0%-5% tension in tails
  - End with no tension
  - I strips to secure ends

### Territories

- Superficial lymphatic drainage areas
  - 4 in torso
  - 3-4 in the legs
  - 6 in the arms (3 in the upper arm and 3 in the forearms)
  - Drain to regional node bed

### Watershed

- Dividing line between territories

### Anastomoses

- Allows for fluid to move between territories or across watersheds
**Tape Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Kinesiology Tape</th>
<th>Athletic Tape</th>
<th>Strapping Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear Time</td>
<td>3-5 days</td>
<td>2-3 hours</td>
<td>1-18 hours</td>
</tr>
<tr>
<td>Pre taping</td>
<td>No pre tape</td>
<td>Pre tape or spray adhesive required</td>
<td>Pre tape required</td>
</tr>
<tr>
<td>Latex free</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Elastic/non-rigid</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Inelastic</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>All full ROM</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Water resistant</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Taping Objectives**

- **Neurosensory** (component in every type of tape)
  - Goals: to improve communication between the tissue and brain to normalize tone of tissue, assist in restoring motor pathways and disrupt pain
    - Kinesiology Taping
    - Specific Proprioceptive Response Taping (SPRT)
    - Functional Movement Taping

- **Structural**
  - Goal: Block injurious ROM, improve adaptive postural behaviors, assist mechanical advantage of a joint, assist in stabilizing laxity/instability
    - Kinesiology Taping
    - SPRT
    - Athletic Tape, McConnell, Mulligan, Strapping Techniques
    - Functional Movement Taping

- **Microcirculatory**
  - Goal: Promote movement of stagnant superficial fluid, edema, bruising, assist in removal of chemical irritants, improve oxygenation to injured tissue
    - Kinesiology Taping

**Precautions**

- Tape allergies
- Geriatric and conditions that cause premature aging
- Congestive heart failure
- Diabetes
- Kidney disease

**Contraindications**

- Tape allergies
- Fragile or healing tissue
- Open wounds
- Cellulitis or infection
- Malignancy site
- Coronary artery disease
- Deep vein thrombosis
- Pregnancy

**Considerations before the application**

- Skin should be cleaned, dry, and free of oils or moisture before application.
- Hair may be clipped or shaved
- Round edges
- Rub tape after application to activate
- Need to be applied 30-45 minutes before activity
- Educate patient regarding the care of the tape for multiple days and safe removal techniques

**Tension Guidelines**

- Light 15-25%
- Moderate 25-35%
- Severe 50-75%
- Full 75-100%
- Paper off 10-15%

*Tension is never placed in the anchor or end*
Other Tips

- If applicable, document the number of “blocks” used
- The objective of the tape
- Targeted muscle or muscle group
- Correlate back to function
- Discuss performance with and without tape

Coding and Billing

- Bill as adjunct therapy
  - CPT Neuromuscular reeducation 97112
  - CPT Therapeutic exercise 97110
  - CPT Manual therapy 97140
  - CPT Self-management 97530
  - CPT strapping codes 29200-29280 and 29520-29590
  - Initial use
    - Strapping refers to the application of overlapping strips of adhesive plaster or tape to a body part to exert pressure and hold a structure in place (CMS)

Coding and Billing

- If billed for independently
  - CPT code 97139 (unlisted therapeutic procedure)
  - CPT code 97799 (unlisted physical medicine / rehabilitation service or procedure)

- Billing for tape
  - HCPCS code A4450 per 18 sq. inches of tape (non-waterproof) or A4452 per 18 sq. inches of tape (waterproof)
  - Check with your third party payor

Evidence Pyramid (Clinical Relevancy)

[Diagram]

PubMed Search

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Number of articles</th>
<th>Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kinesiology taping</td>
<td>27</td>
<td>2003 to present</td>
</tr>
<tr>
<td>Kinesio tape</td>
<td>63</td>
<td>2004 to present</td>
</tr>
<tr>
<td>Kinesio</td>
<td>83</td>
<td>1970 to present</td>
</tr>
<tr>
<td>Kinesiotape</td>
<td>32</td>
<td>1989 to present</td>
</tr>
<tr>
<td>McConnell taping</td>
<td>32</td>
<td>1995 to present</td>
</tr>
<tr>
<td>McConnell tape</td>
<td>26</td>
<td>1990 to present</td>
</tr>
<tr>
<td>Mulligan taping</td>
<td>2</td>
<td>2006 to present</td>
</tr>
</tbody>
</table>

Results of a lunch hour search

- Number of articles
  - May have duplications
  - Need to be thoughtful with search terms
  - MeSH terms (some articles may not be appropriate)

2012 publication

“This systematic review found insufficient evidence to support the use of KT following musculoskeletal injury, although a perceived benefit cannot be discounted. There are few high-quality studies examining the use of KT following musculoskeletal injury.”
Evidence for Edema Management

- **RCT**
  - Bialoszewski et al 2009
    - 24 participants with lower extremity edema
    - Kinesiology taping + PT vs PT only
    - Decreases noted in the thigh with kinesiology taping
  - Han-Je Tsai 2009
    - 43 participants with BCRL
    - Bandaging vs kinesiology taping
    - No difference in volume
    - Acceptance and adherence was better with kinesiology taping

Review

- Choose type of tape – rigid, flexomull, stretch, kinesio, etc.
- Start every technique with an anchor piece and finish with a locking piece
- Apply even pressure
- Don’t overstretch the tape
- Apply tape off the roll
- Avoid continuous taping to prevent constriction
- Smooth all folds and creases to prevent blisters and lacerations
- Observe for possible circulatory complications
- Removal – carefully peel back and use tape scissors, if needed
- Don’t rip off the skin
Case studies

Peripheral Neuropathy Case

Lymphatic Flow case

Lymphatic Flow Case

Lymphatic Flow Case 2

Lymphatic Flow Case 2
Lymphatic Flow Case 2

Taping for Genital Swelling

References


Yakut K, Kirk H. Pain perception induced by electrical stimulation on muscle strengthening training in healthy subjects. Turkish Journal of Physiotherapy and Rehabilitation. 2007;1(1).


Thornton RT, Mendel FC, Fish DR. Effects of Electrical Stimulation on Edema Formation in Different Species of Rats. Physical Therapy. 1990;70:381-394.


References


