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Physical Therapy Treatment of Abdominal Scars, Adhesions, and Abdominal Cutaneous Nerve Entrapments

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Hello!
Course Description

- Abdominal scars, adhesions, and nerve entrapments are a source of abdominal and pelvic musculoskeletal pain symptoms.

- This course will examine and discuss physical therapist examination and treatment of musculoskeletal symptoms that may be caused by or associated with abdominal scars, adhesions, and abdominal cutaneous nerve entrapments (ACNE).

Course Objectives

- Describe the etiology of abdominal scars, adhesions, and nerve entrapments.

- Identify at least three of the physical therapist examination and assessment techniques for symptoms caused by abdominal scars, adhesions, and nerve entrapments.

- Outline at least three interventions for symptoms caused by abdominal scars, adhesions, and nerve entrapments.
Etiology

Scar, Adhesions, Nerve Entrapment

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Poll- Do you provide direct treatment for scar in your practice?
Scar Formation

- Wounds healing is a complex process
- (Hemostasis)
- Inflammatory phase
- Proliferative phase
- Remodeling phase


Inflammatory phase

- Blood clot forms (hemostasis)
- Pro-inflammatory cytokines produced by cells like macrophages and mast cells
- Attract neutrophils
- Day 4 - debris and bacteria are removed
- Angiogenesis begins - 1st blood flow, then nerves follow…
- Fibroblasts activated
Proliferative Phase

- Begins day 4-5
- Lasts for 2-6 weeks
- Growth factors stimulate fibroblasts and keratinocytes
- Angiogenesis allows for growth of granulation tissue
- Epithelialization takes place

Remodeling / Maturation Phase

- Begins after complete closure of wound
- Scar matures for approx. one year
- New tissue with collagen fibers arranged at random transforms to a well-organized network under mechanical stress adding strength to the scar
- Continuous process of degradation and generation of collagen
Common Abdominal Incisions

- Subcostal
- Midline laparotomy - exploratory
- McBurney
- Bilateral subcostal
- Lanz
- Paramedian
- Transverse
- Lower midline
- Pfannenstiel
- Mercedes
- Flank


Abnormal scar

- Normal – thin white line in plane of surrounding skin
- Abnormal – result of dysregulation in wound healing process
  - Contracted- shorter than original wound
  - Hypertrophic- raised, red, itching, painful
  - Keloid-growing into surrounding skin

(Biljard 2017)
Painful scar

- Pain should cease by maturation phase
- Scar neuroma- regenerating nerve is trapped in scar
- Other factors

Etiology of painful scars

- Younger age more likely
- Traumatic memories associated with scar
- Pre-operative/ injury : anxiety
- Post-operative /injury: PTSD, substance abuse, depression

(Bijlard 2017)
Nerve Fiber Density

- Theories
  - Increased density—e.g. cross stimulation leads to central sensitization
  - Decreased density—e.g. diabetic neuropathy, HIV
- Normotrophic matured scars seem to have less innervation than normal skin
- Pathologic and painful scars seem to have richer innervation than normal skin
- Damage or mechanical compression of fibers by dense scar tissue can also be the cause of pain, independent of nerve fiber density.

Neurotrophic Factors

- Nerve growth factor (NGF)
  - Present in high concentrations during wound healing
  - Sensitizes neurons
  - Promotes inflammation releasing other neurotrophic factors
- If healing is prolonged, NGF is elevated, results in directed sprouting and hyperexcitability of axons
Pain and Itch

- Often co-exist in pathologic and burn scars
- Mast cell degeneration substances and neuro-inflammation
- Opioid system- influences inflammatory response and wound healing

Adhesions

Adhesions

- Fibrous bands that span two or more intra-abdominal organs and/or the inner abdominal wall (i.e. peritoneal membrane)
- Typically form after abdominal surgery
- May also form secondary to inflammatory conditions
  - in the absence of prior abdominal surgery
  - as a sequela of abdomino-pelvic radiation

The problem

- Adhesiolysis = Surgical removal or lysis of adhesions
- $2.1$ billion spent on inpatient treatment of adhesiolysis procedures in 2005
  - (Sikirika 2011)
- $50\%$ of women undergoing operations will develop adhesions
  - (Mettler 2012)
- More than $50\%$ of adhesions have nerve fibers in them
  - Tulandi 1998, Kligman 1993
Adhesions cont

- Adhesions are the second most common laparoscopic diagnosis and a major reason for operative laparoscopies
  - Howard 2000
- 4.5% of readmissions after gynecological surgery are directly related to adhesions
  - Lower 2000
- One-third of all cases of intestinal obstruction are secondary to adhesions
  - Ellis 1982
- Moderate-to-severe pelvic adhesions may be responsible for 40% of infertility
  - Franklin 1995

Complications from Adhesions from Abdominal and Pelvic Surgeries

- Bowel obstruction
- Chronic pelvic pain (Perry 2000)
- Pelvic pain exacerbated by sudden movements, activities, or intercourse
- 50% of patients have precipitating factors
  - Surgery, neoplasm, endometriosis, PID
- Dyspareunia
- Infertility
- Higher complication risk in subsequent operations (Mettler 2012)
Biomaterials for Preventing Adhesions

- Hyaluronic acid and derivatives
- Phospholipids
- Gelatin
- Hydrogels
- Microspheres
- Films
- Drugs for prevention
  - E.g. mitomycin C, methotrexate, indomethacin, acetylsalicylic acid, estrogen

Causes

- Post-surgical
  - 90% of adhesions
- Post-inflammatory or infectious
  - Endometriosis and pelvic inflammatory dz most common in women
  - Diverticular disease, Chron’s
- Post-radiation
### Symptoms

- Chronic (persistent or intermittent) bloating.
- Abdominal cramping
- Altered bowel habits, including constipation or frequent loose stools (e.g. from development of small intestinal bacterial overgrowth)
- Nausea with or without early satiety.
- Bowel obstruction, which may be transient, partial, or complete and may cause the aforementioned symptoms.
- Female infertility and dyspareunia
- Rectal bleeding and dyschezia (i.e. painful defecation) during menses, which typically indicate colorectal involvement of endometriosis

### Abdominal Wall Nerve Entrapments

**Abdominal Cutaneous Nerve Entrapments (ACNE)**

Clarke S. Abdominal cutaneous nerve entrapment syndrome. Continuing Education in Anesthesia, Critical Care, and Pain. 15: 2. 2015
Sensory supply to the abdominal wall

- Anterior and lateral cutaneous branches of the anterior rami of the 7th – 12th thoracic nerves
- T7 supplies the infrasternal area and T10 the level at the umbilicus.
- The anterior ramus of L1 is also involved, supplying the area above the pubis as the iliohypogastric nerve (T12, L1)
- Sensory nerves run in a plane between the internal oblique and transverses abdominis muscles
- Each enters a neurovascular channel in the rectus muscle to supply the skin.

Common Symptoms

- Hyperesthesia (burning, tingling) or hypoesthesia (numbness) over the sensory distribution of nerve
- Pain on palpation of the nerve in the area of entrapment / scar - reproductive of the patient's symptoms – in the distribution of the nerve
- Weakness in muscles supplied by the nerve
- Occurrence of symptoms after a surgery or traumatic event – may also occur many months or years after surgery
- Associated with trigger points in abdominal muscles (Wong 2012)
Entrapments of Lumbar Plexus Nerves in Abdominal Wall

- Ilioinguinal
- Iliohypogastric
- Genitofemoral
- Lateral Femoral cutaneous nerve
- Femoral Nerve
- Obturator Nerve
Abdominal Nerve Entrapments Table

- Nerves
  - Iliopsoas

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Abdominal Nerve Entrapment Table 1

- See “Abdominal Nerve Entrapments Table 2017” handout
Table 2

- See “Abdominal Nerve Entrapments Table 2017” handout

Classification of Peripheral Nerve Injury

- Seddon Classification
- Sunderland Classification
- 5 degrees of nerve injury
- Class 1-5
  - 3-5 describe neurotmetic injury
  - 3- nerve fiber interruption
  - 4- epineurium remains intact
  - 5th degree- complete transection of the nerve

Neurapraxia/ neuropraxia

- Interruption of physiologic function w/o significant anatomic damage within the nerve
- No axonal damage
- Transient weakness, numbness, paresthesia
- Recovery in days to weeks

Axonotmesis-

- Wallerian degeneration with axonal damage but nerve sheath remains intact
- Recovery in months or years
Neurotmesis

- Lesion affects both axon and sheath
- Faulty localization of sensory stimuli
- Poor recovery rate

Nerve healing

Nerve Regeneration

- Healthy Neuron
- Damaged Neuron
- Neuron Healing
- Partially Healed Neuron
Case Study

Joy

32 Female y/o Homemaker “Joy”
Coccyx fracture age 12
Closed head injury age 20

- 2010: Vaginal delivery severe perineal injuries
- 6/2014: R ant LQ P ovarian cyst fallopian tube ovary removed
- 6/2015: Persistent R ant LQ P vaginal + pelvic P TVH
- 11/2015: Referred from urogyn to PT
- 2014: 2nd pregnancy PGP severe sciatic
- 2/2015: Persistent R ant LQ P R oophorectomy appendectomy + uterine ablation
- 10/2015: Persistent R ant LQ P vag + pelvic P B pudendal block Botox injections to PFM
Joy’s Initial Presentation

- Daily pain 4/10 --- 7/10 or 10/10
- Worse with sitting, standing, walking, bending, carrying her children or heavy objects, and sneezing
- “Low back” pain, buttock pain, right anterior quadrant pain, vaginal pain, and tailbone pain
- Reports pressure in her bladder, urinates to get pain relief
- In acute distress and fearful of exam
- Meds: diazepam vaginal suppositories daily, uribe, alternating ibuprofen and Tylenol; not effective
- Prior level of function: no pain or dysfunction prior to first pregnancy
- Current level of function: significant difficulty taking care of her two children at home and sometimes unable to care for herself
- Unable to have intercourse x 2 years

Physical Therapist Examination
Abdominal wall

- Asymmetry of ribs, pelvis, skin folds; trunk lateral shift
- Anterior, sagittal B, posterior view
- Scars - observation
- Resting muscle tone
  - Excess tension in external oblique; inferior ribs pulled inward, poor lateral costal expansion
  - Excess tension in internal oblique; inferior ribs flared
- Breathing pattern
  - Apical: chest breathing
  - Abdominal: only belly moves, no chest movement
  - Diaphragm: belly moves first then chest during inhale
  - Which muscles contract during inhale and exhale?

- Observe entire trunk and abdomen from all angles in standing, sitting, and supine
- Screening palpation exam of muscle wall: pick 6-8 points for screening palpation of abdomen for pain in supine
Exam

- Skeletal mal-alignment
- Joint pain (back, ribs, hips)
- Abdominal organ dysfunction (constipation, OAB, dysmenorrhea, infertility)
- Restricted trunk ROM is VERY COMMON

Standing Exam Video

- Standing exam video
Abdominal scar exam videos

- Scar exam 1 video
- Scar exam 2 video
- Scar exam 3 video

Abdominal exam videos

- Ab exam rib iliac inguinal video
- Ab exam Carnett’s test video
- Ab exam cutaneous allodynia video
Carnett’s test

- Palpate abdominal wall and identify painful locations
- Instruct patient to lift head and shoulders to contract abdominal muscles
- If the pain decreases: less likely to be abdominal nerve entrapment or trigger point, possibly visceral dysfunction
- If the pain to palpation increases: then it may be an abdominal nerve entrapment and/or trigger point

Test for Cutaneous Allodynia

- Cotton swab is drawn from the upper abdominal into painful area identified by patient
- In the presence of cutaneous allodynia there is a sharply demarcated area in which this sensation goes from non-painful to a painful sensation
- Size of area can be variable
- Positive test indicates increased likelihood of visceral source of pain

- Jarrell 2011
Neuro-Musculoskeletal Diagnosis

Pelvic Floor Examination
- Vaginal and ano-rectal pelvic floor examination
Bio-psycho-social assessment

Joy’s PT Diagnoses - 2 visits

- Pelvic Girdle Pain
  - SIJ dysfunction
  - Pubic symphysis dysfunction
  - Coccydynia

- Pelvic floor dysfunction

- Abdominal & spinal muscle weakness

- Right hip joint pain
  - Iliopsoas muscle spasm
  - Suspect ilioinguinal nerve entrapment
  - Possible femoral acetabular impingement
  - Extreme muscle weakness
Referral to Interventional Pain Management Specialist

(video from Dr. Spooner)

Diagnostic injections

- Local anesthetic injection
  - In office
  - Under Fluoroscopy
- Initial injection short term duration for diagnostic purposes
- Tinel sign – reproduction of pain with tapping over the nerve distribution or compression site
Electroneurodiagnostic studies

- Motor Nerve conduction
  - MCV = motor conduction velocity tests
  - Identify focal demyelination, generalized polyneuropathy
- Sensory nerve conduction
  - SNAP = sensory nerve action potential
  - Useful in discriminating the site of the pathology based on nerve fiber diameter
- F waves
  - Test long nerves for late motor response
- Needle EMG – electromyography
  - Motor component
  - Denervation and reinnervation
Medical Management

- Medication
- Interventional Procedure Options
  - Joint injections
  - Radiofrequency Nerve Ablation
  - Cryoneuroablation
  - Peripheral nerve blocks / ablation
  - Trigger point injections
  - Botox
  - Sympathetic Blocks and neurolysis
  - Peripheral nerve stimulation implant

Medical Treatments for Nerve Entrapment

- Topical creams and patches
  - capsaicin, lidocaine, Ultram

- Surgical excision
- Surgical scar revision
Medication management for Joy

- Amitriptyline – tricyclic antidepressant
- Bentyl – dicyclomine: antispasmodic
- Gabapentin – anticonvulsant, neuropathic pain
- Hydrocodone – opioid pain medication
- Klonopin – clonazepam: benzodiazepine anti-epileptic

Interventional pain management strategy for Joy

- SIJ block performed immediately
  - considered MBB L4-S2 and RFA if effective but short response.
  - Outcome < 5% improvement in pain or function
- Ilioinguinal nerve block performed- 50% reduction in R LQ P 1 month duration, consider cryoablation
- Consider coccyx/ ganglion impar block
Physical Therapy and Pain Management

- Pain management and physical therapy go “hand in hand” in patients with pelvic pain
- Pain inhibited Joy's ability to participate in physical therapy
- Unable to achieve functional biomechanical loading of the pelvis
- Inhibition of muscle function - motor control, stabilization, coordination, strength

Ability to participate in physical therapy

- Joy had immediate decrease in pain from medication management and ilioinguinal nerve block
- Joy was able to participate in physical therapy
  - Improved biomechanical loading, decreased spasm, improved muscle activation
  - Able to begin strengthening extremely weak core and hips
  - Improved sleep
  - Able to care for self and family
- QUALITY OF LIFE
- RESTORATION OF HOPE
Collaborate!

Poll: Raise your hand if you work directly with an interventional pain management specialist.

Rehabilitation for Peripheral Nerve Injuries

Principles of Intervention

- Control inflammation and the downstream components - pain, scarring, edema, angiogenesis
- Increase flexibility
- Strengthen weakened muscles
- Correct posture
- Improve movement quality

Intervention Principles cont

- Analyze and integrate entire kinetic chain
- Incorporate neuromuscular rehabilitation
- Maintain or improve overall health and fitness
- Patient education
  - HEP, risk factor modification, knowledge of Dx
- Incorporate patient self management
- Ensure safe return to maximum independent function
Physical Agents

- Electrical stimulation for nerve regeneration
  - Low frequency alternating current accelerates axonal regeneration in rats and humans
- Electrotherapeutic modalities for pain modulation
  - Transcutaneous electrical nerve stimulation
- Thermal ultrasound
  - Pulsed US accelerates regeneration in rat models, no evidence to date in humans
- Laser
  - Highly effective agent for tissue repair and pain in rats and humans, evidence is emerging

Manual Physical Therapy

- Assessment and treatment of fascial restrictions at the site of the compression and throughout the length of the nerve
  - Mobilize interfaces and adherent nerve before elongating muscles (neural gliding)
  - Myofascial Release (MFR), soft tissue mobilization
  - Visceral mobilization
- Scar treatment
- Manual therapy techniques / joint mobilization
  - Spinal mobilization / manipulation
  - Pelvic joint mobilization (SIJ, pubic)
  - Hip joint mobilization
Functional Training

- Instruction in posture and body mechanics
- Self correction of joint loading strategies
- Avoidance of tight clothes and belts: Lateral femoral cutaneous

PT Intervention
Bio-psycho-social / Functional

- Pain neuroscience education
  - (Louw 2011)
- Cognitive strategies
- Pain management strategies
  - TENS (Mira 2015)
  - Specific self treatments
  - Diaphragmatic breathing
  - Aromatherapy
  - Guided meditation
- Functional retraining
  - Sexual positions, musculoskeletal and cognitive strategies for sex
  - Household duties
  - Childcare
  - Travel
Physical Therapy Intervention
Abdomino-lumbo-pelvic–hip

Scar massage
- Begin at least 3 weeks after surgery
  - Sutures removed, scabs have fallen off
  - Can massage around the scar
- Massage in circles, vertical, horizontal
- 5-10 minutes, 2-3x/day
- For at least 6 months after surgery
- Wait one month before using Vitamin E
Scar Desensitization

- The process by which immediate hypersensitivity of scar and surrounding tissues is reduced via graded or progressive exposure to tactile stimulus
- Especially helpful if the patient has anxiety or other emotions associated with the scar
- Graded exposure: Begin with exposure to fabrics:

Graded Exposure To Fabrics

- Start with a soft cotton fabric and apply gently across the scar and surrounding tissues in all directions
- Progress to using a rough, wet towel
- Repeat with a dry towel if tolerated
- Soft/medium clean sponge
- Lamb’s wool, t-shirt, denim are some different types of materials that can help with desensitization
Scar Treatments

- Silicone gel pads
- Creams
  - Mederma
  - Topical Vitamin A
- Laser
- Botox
- Stem cell
- Surgical revision


Scar Rx videos

- Scar rx 1 video
- Scar rx 2 video
- Scar rx 3 video
- Scar rx 4 video
Ab trunk mobility videos

- Ab rx trunk mobility 1 video
- Ab rx trunk mobility 2 video
- Ab rx trunk mobility 3 video
- Ab rx trunk mobility 4 video

Ab Rx videos (5)

- Ab rx breathing video
- Ab rx psoas counterstrain video
- Ab rx psoas rel video
- Ab rx psoas stretch video
- Ab rx psoas stand stretch video
Joy’s Outcomes (in progress...)

- 50% reduction in primary R anterior lower quadrant pain,
- 50% reduction in overall pain
- Able to perform therapeutic exercise program
- Able to care for self and children
- Able to travel by car to home in Arkansas
- Able to have intercourse
- MCID changes achieved in all validated outcome measures
Case discussion

Thank you for your time and attention