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Screening for Musculoskeletal Causes of Pelvic Pain

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The Musculoskeletal System As A Source of Pelvic Dysfunction

Chronic pelvic pain has long frustrated both a wide range of medical specialists and countless patients. In the past, research consistently demonstrated three general themes: the high numbers of women affected; the high percentage of misdiagnoses; and the extreme failure rates of medical intervention. Recent work, however, has begun to show more successful results, reflecting a broader understanding of the multifaceted nature of chronic pelvic pain. This improvement appears to be related to a changed approach (ie, a multidisciplinary model of patient care in contrast to earlier compartmentalized treatment).

As women with complaints of pelvic pain often present with urologic, gynecologic, gastrointestinal, neurologic, or musculoskeletal symptoms, the first step is to establish an accurate diagnosis. It may not be within the purview of the examiner to treat all the possible causes; however, all examiners can possess the knowledge to recognize many types of dysfunction, even those in areas outside their specialty, and to assist in recommending appropriate treatment.

Research has shown that the musculoskeletal system is involved in disorders such as vulvodynia, coccygodynia, levator ani syndrome, fibromyalgia, endometriosis, vulvar vestibulitis syndrome, dyspareunia, vaginismus, pelvic floor tension myalgia, urgency–frequency syndrome, interstitial cystitis, urethral syndrome, irritable bowel syndrome, and pudendal nerve entrapment/pudendal neuralgia.[1–7] Whether musculoskeletal dysfunction is a primary cause of symptoms or an effect of pathology elsewhere, it is crucial that it be addressed to achieve a successful outcome. Therefore, the purpose of this report is to broaden clinicians' perspective of chronic pelvic pain to include the musculoskeletal system; to provide them with tools to perform a preliminary musculoskeletal examination; and to enable them to educate the patient about

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musculoskeletal dysfunction and physical therapy as a treatment option for pelvic pain.

Screening for Musculoskeletal Dysfunction

ORAL HISTORY

Many clinicians are aware that the symptoms of deep muscular and visceral dysfunction are often similar. The pain is diffuse and often accompanied by autonomic complaints. Visceral and somatic referred pain patterns further add to the diagnostic confusion. Therefore, it is essential to examine all potential muscular and visceral sources of pain.

An easily identifiable culprit in musculoskeletal dysfunction is a stress or trauma that preceded or exacerbated the pelvic pain. The timing of the event is much less important than the event itself; indeed, the predisposing injury could have occurred as early as childhood. Patients do not often consider such incidents relevant, and they may never have been diagnosed with an orthopedic dysfunction. The patient therefore needs to be questioned. Falls on the tailbone, hip, pelvis, or low back; lower extremity injuries or surgeries; sacroiliac dysfunctions and other orthopedic diagnoses should alert the clinician to examine the musculoskeletal system more closely. Inquiring into a patient's functional abilities can also yield helpful information, particularly with regard to activities impaired by increases in symptoms (eg, running or swimming the breaststroke).

Purposes of the musculoskeletal system include support and locomotion. Although age and prior level of function are important considerations, pathology can be suspected if symptoms increase or decrease with certain positions (eg, sitting), postures, activities, or times of day. Musculoskeletal dysfunction tends to worsen with stress, does not typically respond to intervention focused on other systems, and often does not awaken the patient at night.[8]

The characteristics and causes of muscles spasms, whether or not the problematic muscle is directly in or on the bony pelvis, can be responsible for perpetuating pain and dysfunction.[6–8] For example, a patient may have a whiplash injury resulting in a quadratus lumborum spasm. This seemingly unrelated situation could eventually lead to pelvic pain. For many reasons, the muscle may remain in spasm or in a shortened position. Shortened muscles are often weak and, therefore, more likely to develop myofascial trigger points (MTrPs; see Muscular Component, below). As Travell and Simons have demonstrated,[6] MTrPs in the low back, abdominals, lower extremities, and pelvic girdle can be primary referral sources of pelvic pain. Another potential problem could be that the shortened quadratus lumborum creates an apparent leg-length discrepancy, and therefore a pelvic obliquity. This could lead to sacroiliac joint dysfunction and pelvic floor muscle imbalance. Two muscles frequently thus affected are the pubourethralis and obturator internus.[2,9] Symptoms of a hypertonic pubourethralis muscle include urgency–frequency, suprapubic pain, and aberrant urinary flow. In spasm, the obturator internus can irritate the pudendal nerve in Alcock's canal and lead to clitoral/perineal discomfort that worsens with sitting. Vaginismus of the pelvic floor could result, and now the list of complaints includes dyspareunia. These are probable examples that can assist the gynecologist in linking musculoskeletal problems to gynecologic symptoms.

Research has demonstrated that visceral dysfunction and organ disease can also involve the muscles of the pelvic floor and related connective tissues.[7,10,13] Multiple yeast or urinary tract infections are two examples. When a patient complains of vulvar discomfort and/or urinary urgency and frequency without culture-proven evidence of infection, a musculoskeletal origin is highly probable. Recurrent yeast or urinary tract infections can cause pelvic floor muscle spasms through spinal cord reflexes be-

tween the mucosa and muscles. The hypertonic muscles cause local compression of the urethra and vagina, and the combination of the local compression and neural mechanisms perpetuate vulvar and urinary symptoms. Typically, a patient is unaware that muscle spasms can create these symptoms, and they should be educated to the possibility that a musculoskeletal dysfunction could create these very symptoms when cultures return negative.

Musculoskeletal problems also arise from other pathologic conditions and medical interventions intended to treat symptoms of pelvic pain. Examples include diastasis recti after childbirth, surgical scars and adhesions, and the coexistence of endometriosis and pelvic floor dysfunction.[4]

Gleaning information regarding periods of relative exacerbation and relief of symptoms can be helpful. Whether exacerbation results from a urinary tract infection, childbirth, a long bike ride, or a car accident, one can begin to appreciate how pelvic pain symptoms are the result of cumulative traumas. Each incident has an impact on the body and can culminate in acute symptoms. When a clinician hears such reports, he or she should proceed with an objective musculoskeletal examination.

OBJECTIVE EXAMINATION

In today's world of managed care, it is impractical for the gynecologist to perform a complete and thorough musculoskeletal examination. Therefore, this section will direct the physician to examine the body grossly for potential sources of pelvic pain. The musculoskeletal areas to be examined are superficial connective tissues; sites where the peripheral nerves could evoke adverse neural tension; internal and external muscle groups; and, finally, the general structure (including posture).

Connective Tissue

Loose connective tissue, particularly the cutaneous and the subcutaneous structures superficial to muscle, is an important consideration when dealing with pelvic pain. Reflexive cutaneous changes in response to visceral disturbances were documented as early as 1893. Sir Henry Head demonstrated that visceral disturbances can induce cutaneous hypersensitivity and trophic changes in sites distant from the actual pathology.[14] Recent studies have further explored the viscerocutaneous reflex and referred pain mechanisms pertaining specifically to pelvic disorders[12,13]; they demonstrate that inflammation in the bladder or uterus results in vasoconstriction of the connective tissue in the abdomen, lower back, pelvic girdle, and thighs. The viscerocutaneous reflex is one example of the phenomenon known as viscerosomatic convergence, in which the visceral and somatic afferent nerves converge on the same dorsal horn transmission cell of the spinal cord.[15]

The defined cutaneous referral zones need to be examined for trophic changes and hyperalgesic responses. The examination can begin with assessment of these connective tissues. Although patients are typically aware of problems in their muscles or joints, they are often unaware of connective tissue dysfunction. However, depending on the duration and severity of the problem, a patient may notice a spectrum of nuisances, ranging from general irritation from underwear or tight clothing to complete intolerance of certain or all fabrics on the skin. Other situations where the skin is compressed (such as when sitting) may also be uncomfortable. Beyond the functional limitations, connective tissue restrictions create adverse tension on many layers of tissue and muscle and on peripheral nerves; via antidromic reflexes they can lead to neurogenic inflammation of visceral structures.[16] Identification and treatment of connective tissue dysfunction will be crucial to the long-term success of intervention.

To examine the connective tissue, the skin and subcutaneous layers superficial to the muscle can be gripped between the thumb and fingers. Do not pinch the patient's skin as the examining hand attempts

to move through the tissue. When compared with non-involved regions, dysfunction can be identified through textural changes and patient reports of tenderness disproportionate to the pressure applied.

Identified dysfunction can be treated with connective tissue manipulation by a skilled practitioner. This will result in better circulation, tissue integrity, overall movement of deep and superficial structures, and endocrine improvements via stimulation of autonomic reflex pathways.[11] Functionally, patients will have less sensitivity to clothing and discomfort when sitting. Connective tissue manipulation will quiet visceral pain and dysfunction, as neurologic reactive adaptations occur in both directions.[10,11]

Peripheral Nerves (Adverse Neural Tension)

In addition to traditional sensory and motor neurologic testing, a clinician should always test the peripheral nerves for adverse neural tension. The peripheral and central nervous systems form a continuous tissue tract. This occurs by three mechanisms: through connective tissues; electrically by neurons that allow information to flow from the brain to the periphery and back; and chemically, with the neurotransmitters that exist both centrally and peripherally.[17] This system is mobile; the spinal canal is 5 to 9 cm longer flexed than extended. The existing continuity also allows the system to be stretched or slackened and therefore to be able to adjust mechanically or, conversely, to be subjected to mechanical trauma. The sinuvertebral nerves innervate dura mater, and the connective tissues of peripheral nerves, the nerve roots, and the autonomic nervous system have intrinsic innervations.[17,18] Consequently, any of the aforementioned structures can be a source of pelvic pain symptoms.

Adverse neural tension is defined as "abnormal physiological and mechanical responses produced from nervous system structures when their normal range of movement and stretch capabilities are tested."[17] Examples of peripheral nerves subject to adverse tension and resultant pelvic pain are the iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, femoral, pudendal, sciatic, obturator, and ilioinguinal. When under adverse tension, these nerves can refer pain within their somatic innervations or to visceral structures (Table 1). This pain referral is a manifestation of the aforementioned visceral–somatic convergence. The somatic components typically involved in pelvic pain are connective tissue, peripheral nerves, and muscles.

A mechanical interface is defined as "that tissue or material adjacent to the nervous system that can move independently to the system."[17] Inadequate motion between mechanical interfaces can begin a pathologic process. Research has demonstrated many "tension points" between interfaces along various peripheral nerves, and they consti-

TABLE 1. Peripheral Nerve Causes of Pelvic Pain*

Nerve	Sensory Innervation	Visceral Field of Referred Pain
Iliohypogastric	Posterior superior gluteal region, anterior suprapubic area	Ovary and distal Fallopian tube
Ilioinguinal	Medial thigh and lateral labia majora, below inguinal ligament	Proximal tube and uterine fundus
Genitofemoral	Proximal anterior thigh	Proximal tube and uterine fundus
Lateral femoral cutaneous	Lateral anterior thigh	Fundus and lower uterine segment
Pudendal	Dermatomes S_2–S_4, perineum, perianal area	Lower uterine segment, cervix bladder, distal ureter, upper vagina, rectum

* Data drawn from references 4 and 15.

tute one of the numerous potential sources of symptoms generated from the nervous system. Butler has defined five vulnerable anatomic situations.[17] Soft tissue, osseus, or fibroosseous tunnels are one site. Alcock's canal within the obturator internus, for example, is an interface to the pudendal nerve. A pelvic floor muscle spasm can result in a lack of mobility within this canal, and one of the many clinical representations of pathology here is perineal pain with sitting. Rather than the nerve's moving within the canal, it is being compressed and subjected to tension with the movement, and any structure innervated by the pudendal nerve or the more distal branches may seem to be generating pain.

Another vulnerable site is where the nervous system branches, especially at a sharp angle. Again, the pudendal nerve is an example as it dives into the pelvic floor musculature after exiting the sacrum. A third site includes places where nerves are relatively fixed. This can occur when surgical adhesions create connective tissue restrictions. The ilioinguinal and genitofemoral nerves have been known to become adhered after laparoscopy for endometriosis.[4] Butler's other sites are places of unyielding interface and other areas of tension through dysfunction. With the pudendal nerve as an example again, a sacroiliac joint dysfunction (see Oral History) resulting in tension and inflammation of the sacrotuberous and sacrospinous ligaments can pinch and cause fixation of the pudendal nerve.

Adverse neural tension can be responsible for pain that seems to come from any structure innervated by the nerve or any point along the neural pathway. Characteristics of neural pain often include stabbing, burning, itching, or electrical sensations. Once the nerve structure is altered from irritation, the pain may persist even after the aggravating stimulus is removed.

An understanding of the functional anatomy of the pelvis will enable the clinician to test for adverse neural tension of the suspicious nerves. Two components of the examination are useful for immediate clinical application in the gynecology office: palpation and neurodynamic testing. Nerves do not typically hurt when palpated; if sensitivity is present, changes may be occurring locally or even in the threshold of the entire nervous system. It is recommended that a nerve be palpated with a flat finger, applying pressure that turns the tip of the examiner's fingernail white. Using the tip of a finger, the examiner can "twang" the nerve.[18] He or she is looking for local tenderness and/or distal paresthesias. It is possible that all nerves may be tender secondary to central sensitization processes. Furthermore, connective tissue restrictions, hypertonicity, and MTrPs in the surrounding tissues can lead to false-positive findings on palpation. For this reason, no conclusions should be made until all components have been examined.

Any peripheral nerve that crosses at least one joint or exists in a muscle can be tested neurodynamically as well. Neurodynamic testing is based on the principal that nerves are mobile structures that, in the absence of pathologic tension, should allow complex movement and lengthening without eliciting symptoms. This can best be explained by example. The sciatic nerve is a continuation of the sacral plexus, and it innervates the majority of the muscles in the posterior thigh and leg. With the patient supine, the examiner flexes the patient's hip up to 90 degrees with the leg maintained straight. As the hip flexion increases, the tension on this nerve will as well. In the absence of adverse neural tension, the patient should not feel any symptoms of sciatica. Dorsiflexion of the foot will further increase tension. These examples presume that the joints and muscle length will allow the desired range of motion. If nerve paresthesias are elicited, the test result is positive.

In another example, neurodynamic testing can be applied to the pudendal nerve at Alcock's canal—within the obturator internus muscle. The nerve can be palpated here per vagina with the patient in lithotomy po-

sition, noting tenderness. As the obturator internus is an external rotator of the thigh, placing the leg in internal rotation will stretch the muscle and the nerve. Continued palpation will demonstrate an increase in sensitivity of the nerve now that it is on stretch. If this occurs, there may be restriction at this location or another interface where the nerve passes, such as between the sacrotuberous and sacrospinous ligaments. Functionally, many patients with pudendal neuralgia cannot perform a deep squat without pain in some or all of the pudendal nerve distribution. The examiner can assess this motion also if suspicious of pudendal nerve involvement.

Treatment Considerations

When adverse neural tension is detected, treatment involves mobilization of the nerve. Neural tissues are noncontractile, and therefore they should not be stretched. If adverse tension coexists with muscle hypertonicity, care must be taken to mobilize the nerve before lengthening the muscle. Stretching a hypertonic muscle with nerve fixation may lead to further neural tension and an exacerbation of symptoms. Therefore, treatment protocols need to incorporate this hierarchy of care to be successful. Mobilization involves restoring movement between interfaces where it is limited. One way to achieve this is by gliding the nerve through movements that lengthen it across one area while shortening it simultaneously in another.

Muscular Component

The muscles of the abdominal region, pelvic floor and girdle, low back, and lower extremities need to be examined for hypertonicity, the result of stimulation from visceral or musculoskeletal nociceptors. Commonly, but not always, hypertonic muscles harbor MTrPs. Travell and Simons define a MTrP as "a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band. The spot is painful on compression and can give rise to characteristic referred pain, referred tenderness, motor dysfunction and autonomic phenomena."[6]

External Muscle Examination

Table 2 lists symptoms caused by MTrPs in the low back, abdominal wall, lower extremities, and pelvic girdle. Each of the muscles listed should be examined. The trigger points are typically identified by applying sustained deep pressure in the suspicious area with the muscle in question on slack. Clinical criteria include tenderness in a taut band, pain referral, a local twitch response, decreased lengthening ability of the involved muscle, and, finally, muscle weakness despite atrophy.[6] During examination, it should be borne in mind that trigger points, even if unilateral, may produce bilateral symptoms and may also be subject to hormonal influence.

Internal Muscle Examination

After external muscle examination, the muscles of the pelvic floor should be examined for hypertonicity, MTrPs, and the ability to contract and relax concentrically and eccentrically. Women with pelvic floor dysfunction may find internal examination painful; therefore, it is best to use a single digit, lubricated with anesthetic jelly, to avoid exacerbating existing skin sensitivity. The muscles can be easily accessed with the patient in lithotomy position. If excessive vaginismus is present, asking the patient to bear down will elicit an eccentric lengthening that will aid finger insertion.

Once a finger is inserted, asking the patient to squeeze the finger will give the examiner an idea of the ability to contract the pelvic floor concentrically. Both the strength of the contraction and the degree of subsequent relaxation should be noted. Many patients are able to contract, but relaxation may be slow and incomplete. The muscle may appear weak for different reasons, and distinguishing the cause is important for an appropriate treatment plan. For example, the patient may not have the range

TABLE 2. Muscular Causes of Pelvic Pain

Muscle	Referred Pain Area	Symptoms
Iliopsoas	Ipsilateral spine (thoracic, upper buttock), anterior thigh, groin, lower abdomen	Pain with weight-bearing or hip extension
Piriformis	Low back, buttock, pelvic floor	Pain in referred areas worsening with sitting, standing, walking; sciatica
Quadratus lumborum	Sacroiliac joint and buttock, anterior ilium, lower abdominal region, groin, greater trochanter	Pain in low back and with walking, coughing, or sneezing
Abdominal Muscles		
Transverse	Groin, inguinal ligament, detrusor and urinary sphincter spasm	Urinary frequency or retention, groin pain, bladder pain
Rectus	Across thoracolumbar back, xiphoid process, sacroiliac joints and low back	Somatovisceral response, projectile vomiting, anorexia, nausea, intestinal colic, diarrhea, dysmenorrhea
Gluteus maximus	Buttock region	Pain with prolonged sitting, walking uphill, or swimming the crawl stroke
Gluteus medius	Posterior crest of the ilium, the sacrum, posterior and lateral buttock	Pain with walking, lying on one's side, and sitting
Sphincter ani, superficial transverse perinei, levator ani, coccygeus	Coccyx, anal area, lower sacrum, vagina	Tailbone, hip and back pain, painful bowel movements, perineal pain with sitting
Ischiocavernous and bulbospongiosus	Genital structures	Dyspareunia, perineal ache
Obturator internus	Vagina, anococcygeal, posterior thigh	Rectal fullness, posterior thigh pain

of motion necessary for concentric contraction. Many biofeedback devices that rely on surface electromyography sensors will also detect weakness, even though the actual cause may be a faulty length–tension relationship of the muscle fibers.

Research has demonstrated that maximal muscle contraction occurs within a specific range of overlap between the contractile elements of muscle fibers.[19] Muscles placed in shortened positions, therefore, cannot generate as much tension as they typically would in a normal position and can mistakenly appear weaker than they actually are. Therefore, one cannot conclude the degree of deficit from this test alone. Repeating the contraction test after the pelvic floor muscles have been stretched will demonstrate an increase in force if the apparent weakness was the result of the shortened test position. These factors must be kept in mind when designing a treatment protocol.

An attempt to strengthen muscles with Kegel exercises when they are already in a shortened position can lead to further hypertonicity and a delay in progress or even an exacerbation of symptoms. Trying to strengthen a muscle concentrically that is not capable of full relaxation will also be counterproductive. Therefore, muscles must be returned to a normal resting length and possess the ability to relax after a concentric contraction before a strengthening program will be successful.

Applying posterior pressure will allow the examiner to determine the tone and tenderness of the pubovaginalis portion of the levator ani muscle (Fig. 1). The obturator internus and the piriformis can be palpated laterally; however, the levator ani group may also be responsible for tenderness in this region. Typically, the tenderness of hypertonic muscles under palpation increases when a muscle contraction is elicited. In-

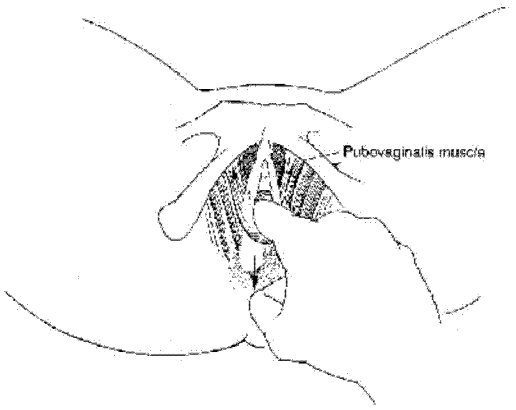

FIGURE 1. Palpation of the pubovaginalis portion of the levator ani. This assessment technique can also be applied as treatment, with the test position held for 30 seconds (reprinted from reference 7).

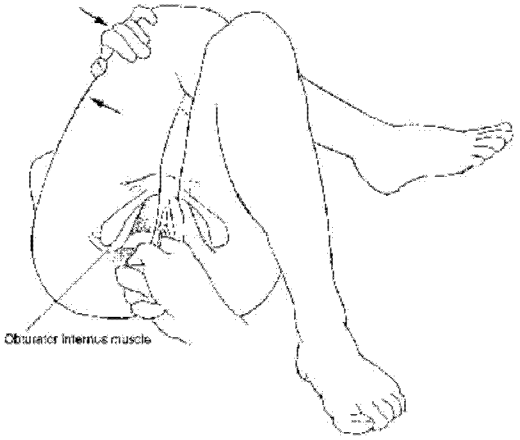

FIGURE 2. Palpation of the obturator internus muscle on stretch (reprinted from reference 7).

structing a patient to "squeeze the finger" will engage the levator group. In contrast, the patient can be asked to produce an isometric contraction of the external rotators by pushing the ipsilateral thigh laterally against the examiner's free hand. This will help differentially diagnose which muscle is involved. Again, tenderness and trigger points should be noted, and it is not unlikely that both muscles will prove problematic. Putting the obturator internus muscle under tension (Fig. 2) will make muscle hypertonicity and tenderness more easily identifiable. The fascia of the obturator internus contributes to Alcock's canal and houses a portion of the pudendal nerve. If the nerve is under adverse tension, the patient will report sharp pain with palpation in contrast to the diffuse ache typical of muscle hypertonicity. The nerve can also be palpated for tenderness along the ischial spine and between the sacrotuberous and sacrospinous ligaments. Placing a forefinger 1 cm internally on the superior portion of the labia and applying external pressure with the thumb can palpate the dorsal clitoral nerve branch. This may reproduce clitoral and/or urethral pain.

The urethral sphincter and pubourethralis should be examined next (Fig. 3). Compressing these areas between the examiner's finger and the pubic symphysis will elicit tenderness and/or feelings of urgency if the muscle is problematic. An examiner may do

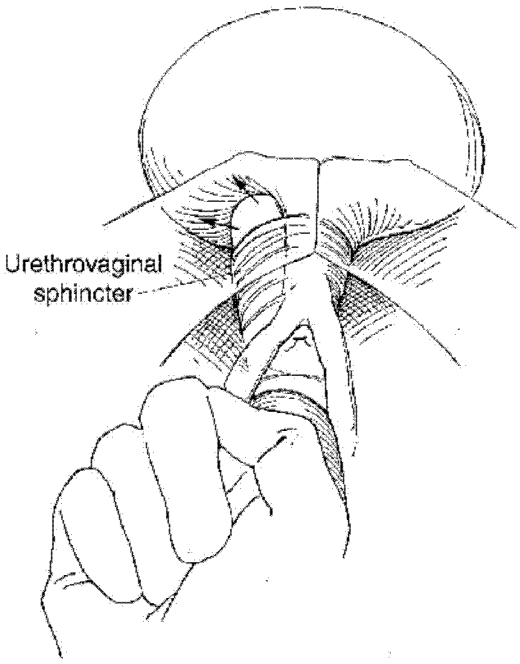

FIGURE 3. Palpation of the urethrovaginal sphincter (reprinted from reference 7).

a bimanual examination with the free hand by gently pushing through the tissue just superior to the pubic symphysis to meet the internal hand.

A rectal examination will allow the clinician to determine the integrity of the anal sphincter and coccygeus and the degree of coccyx flexion and extension. Normal coccyx motion is about 30 degrees and should not be painful. The coccygeus should be palpated on both sides, lateral to the coccyx. Again, resisted isometric contractions will help the examiner palpate the piriformis and obturator internus.

Structure

Structural abnormalities, such as an excessive anterior tilt of the pelvis or hyperlordotic curve of the lumbar spine, apparent or true leg-length discrepancies, pelvic obliquities, scoliosis, and poor posture, tend to contribute to muscular dysfunction and referred pelvic pain patterns. Mobility restrictions, strength deficits, and faulty neuromuscular recruitment patterns also contribute to chronic pelvic pain. However, obtaining precise measurements of these components is time-consuming and typically necessary only if the practitioner is designing the treatment plan to address them.

Physical Therapy as a Treatment Option

The services offered by physical therapists have been used increasingly to treat chronic pelvic pain. Although pelvic floor biofeedback has been widely publicized and accepted as a treatment option for women with pelvic floor disorders,[1] skilled urogynecologic physical therapists possess a wide range of other successful techniques. These include mobilization of nerves under adverse tension and restricted joints; connective tissue manipulation; myofascial release (both to the external muscle groups and internally to the pelvic floor per vagina and/or rectum); and proprioceptive neuromuscular facilitation techniques to assist in correcting dysfunctional findings and managing pain in the pelvic region. Manual therapy is known to induce somatic and visceral improvements via mechanical and reflexive actions of the nervous system.[10,11] Each patient is unique in her subjective and objective clinical and personal presentation, and successful therapy requires an individualized accumulation of techniques. No simple standardized approach or protocol exists to treat this population.

The symptoms of pelvic pain often do not appear to be of such a nature that the patient seeks out a physical therapist for help. Furthermore, many state laws require physician referral. The first step in the process, therefore, can lie with the physician who is able to identify musculoskeletal disorders.

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