71

TREATMENT OF THE ACUTELY ILL HOSPITALIZED PATIENT

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KEY CONCEPTS

An osteopathic structural examination:

- Providing clues to the medical/surgical diagnosis of a hospitalized patient
- Directed toward the underlying pathophysiology of the disease process

An individualized osteopathic manipulative treatment plan:

- At each visit
- For each acutely ill hospitalized patient
- Specifically directed toward dysfunction, discovered during a musculoskeletal structural examination
- Appropriate for the patient's condition and directed toward improving physiologic function
- For support and assistance to the patient recovering from an illness or other acute stress

The science of osteopathy is applicable to the full spectrum of medical and surgical problems. Osteopathic evaluation and treatment, integrated into the care of the acutely ill hospital patient, is based on an understanding of the mechanical and functional aspects of the body's viscera and systems, including the respiratory, circulatory, the immune, and autonomic nervous systems. This chapter specifically presents a template for an osteopathic structural evaluation that investigates body physiology related to a patient's disease processes, not just the mechanics of the neuromusculoskeletal system, and as such, becomes an invaluable part of the physical examination. It presents the general principles upon which the treatment plan is based and suggests manipulative treatment techniques that apply these principles. The resulting treatment plan is a natural extension of the structural examination. The osteopathic treatment that is administered supports the patient and assists in their recovery from illness or other acute stress. A unique and individualized treatment plan must be designed for each acutely ill hospitalized patient at each visit.

THE STRUCTURAL EXAMINATION

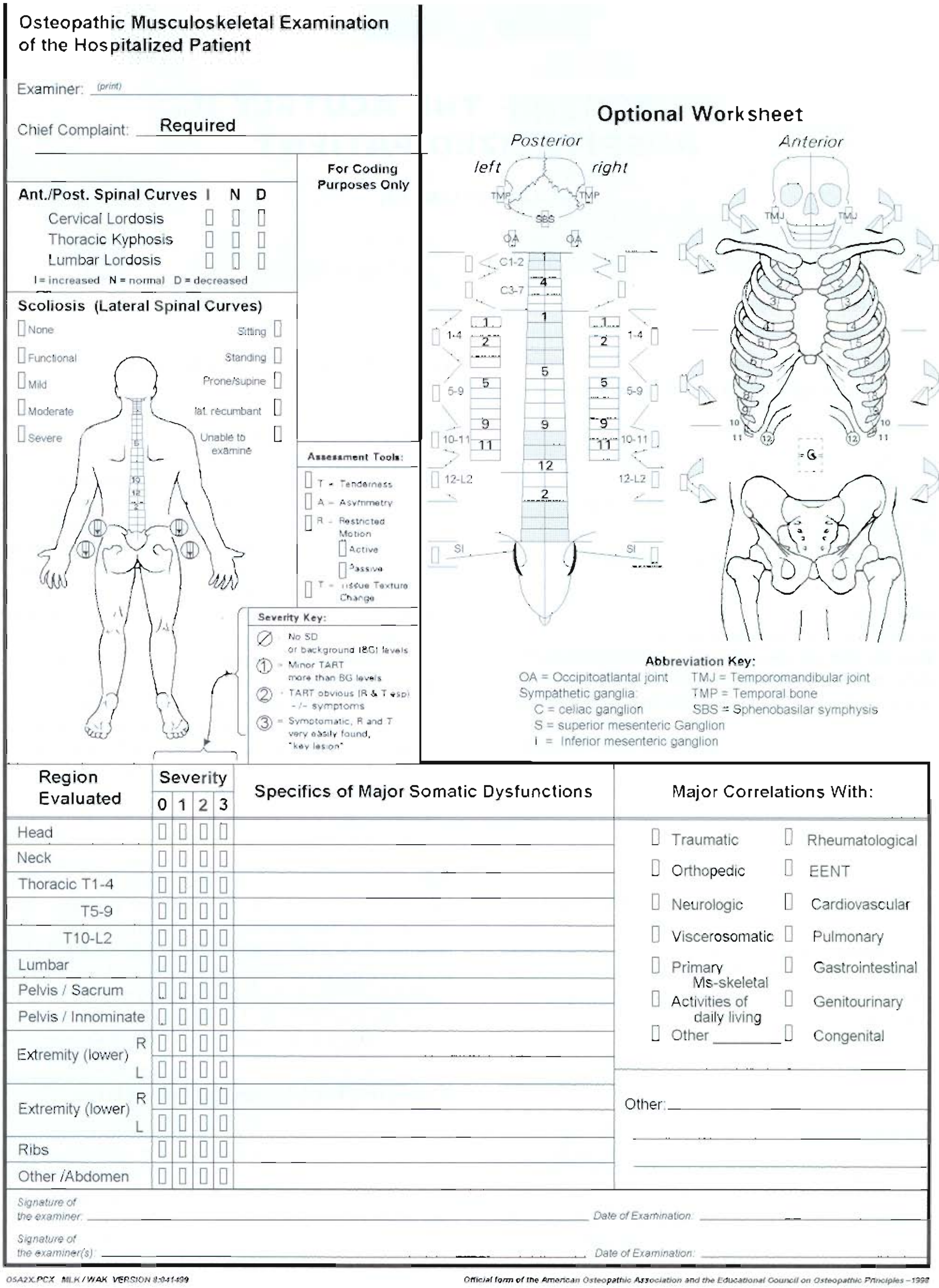
Accurate diagnosis is the key to appropriate treatment of any patient with any disease process. For this reason, a basic structural examination should be performed on all hospital patients. The structural examination offers the osteopathic physician additional clues that assist in the overall assessment of a patient's condition and the development of an appropriate treatment plan. The hospital structural examination is a variation of the general structural examination described in Chapter 44. The American Osteopathic Association (AOA) has designed a standardized hospital structural examination form for use in all osteopathic services (Fig. 71.1).

This examination consists of required and optional parts. The required section, which includes static symmetry, both anteroposterior (AP) and lateral, and regional screen for tissue tension, fulfills the requirements of a basic musculoskeletal examination. This part of the examination is described in Chapter 44. Adaptations must be made for the condition of the patient; some patients are unable to sit, stand, or walk.

Although listed as optional, this author strongly recommends that the focused examination described herein be carried out in the acutely ill patient, as it will provide clues to the diagnosis and overall condition of the patient. It assesses the function of the patient's major organ systems. Also, if an osteopathic manipulative treatment is to be performed on a hospitalized patient, a focused musculoskeletal examination is required. Notes regarding the focused examination can be recorded in the "optional" region of the standardized form, for later dictation with the physical examination or the progress notes. The aspects of this focused structural examination will be described in detail in this chapter.

Assessing for Segmental Facilitation

Reflex somatic dysfunction provides important clues to the presence of acute and/or chronic disease. The information gathered is combined with the rest of the physical examination to reach a working differential diagnosis. In order to most accurately interpret structural findings as they relate to the systemic diseases they reflect, reflex somatic dysfunction must be differentiated from postural, traumatic, and other purely somatic causes of somatic



Osteopathic Musculoskeletal Examination of the Hospitalized Patient

Examiner: (print) ______

Chief Complaint: Required

Optional Worksheet

Ant./Post. Spinal Curves	I	N	D
Cervical Lordosis	▯	▯	▯
Thoracic Kyphosis	▯	▯	▯
Lumbar Lordosis	▯	▯	▯

I = increased N = normal D = decreased

For Coding Purposes Only

Scoliosis (Lateral Spinal Curves)

▯ None ▯ Functional ▯ Mild ▯ Moderate ▯ Severe

Sitting ▯ Standing ▯ Prone/supine ▯ lat. recumbant ▯ Unable to examine ▯

Assessment Tools:

▯ T – Tenderness
▯ A – Asymmetry
▯ R – Restricted Motion ▯ Active ▯ Passive
▯ T – Tissue Texture Change

Severity Key:

∅ = No SD or background (BG) levels
① = Minor TART more than BG levels
② = TART obvious (R & T esp) +/– symptoms
③ = Symptomatic, R and T very easily found, "key lesion"

Abbreviation Key:

OA = Occipitoatlantal joint
Sympathetic ganglia:
C = celiac ganglion
S = superior mesenteric Ganglion
I = Inferior mesenteric ganglion
TMJ = Temporomandibular joint
TMP = Temporal bone
SBS = Sphenobasilar symphysis

Region Evaluated	Severity 0	1	2	3	Specifics of Major Somatic Dysfunctions
Head	▯	▯	▯	▯	
Neck	▯	▯	▯	▯	
Thoracic T1-4	▯	▯	▯	▯	
T5-9	▯	▯	▯	▯	
T10-L2	▯	▯	▯	▯	
Lumbar	▯	▯	▯	▯	
Pelvis / Sacrum	▯	▯	▯	▯	
Pelvis / Innominate	▯	▯	▯	▯	
Extremity (lower) R	▯	▯	▯	▯	
L	▯	▯	▯	▯	
Extremity (lower) R	▯	▯	▯	▯	
L	▯	▯	▯	▯	
Ribs	▯	▯	▯	▯	
Other /Abdomen	▯	▯	▯	▯	

Major Correlations With:

▯ Traumatic ▯ Rheumatological
▯ Orthopedic ▯ EENT
▯ Neurologic ▯ Cardiovascular
▯ Viscerosomatic ▯ Pulmonary
▯ Primary Ms-skeletal ▯ Gastrointestinal
▯ Activities of daily living ▯ Genitourinary
▯ Other ______ ▯ Congenital

Other: ______

Signature of the examiner: ______ Date of Examination: ______

Signature of the examiner(s): ______ Date of Examination: ______

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Official form of the American Osteopathic Association and the Educational Council on Osteopathic Principles – 1998

FIGURE 71.1. The American Osteopathic Association standardized hospital structural examination form.

dysfunction. There are unique qualities of viscerosomatic reflexes, which are related to the known pathophysiology of the reflex and the unique tissue changes they create. A viscerosomatic reflex is produced by the stimulation of nociceptors (pain carrying sensory fibers) within the diseased viscera or its fascia. Nociceptors are particularly sensitive to inflammation, and their exaggerated response to inflammatory processes may explain the distinct and identifiable tissue changes they produce. For this reason, reflexes are most apparent in diseases associated with acute inflammation, particularly those with a presenting complaint of pain, and may not be evident in a patient with a malignant tumor if the tumor is not causing irritation or inflammation. The nociceptive input travels to interneurons in the dorsal horn of the spinal cord, where it converges with nociceptive inputs from all somatic tissues. These interneurons stimulate both sympathetic efferent fibers and α-motor neurons.

Stimulation of sympathetic outflow nerves produces changes in blood supply and sweat gland activity at the body surface, in addition to visceral motor changes. I.M. Korr measured the cutaneous changes produced by segmental facilitation via alterations in skin resistance (sweat) and temperature (blood flow) (1). These changes are palpable as increased temperature and sweat (moisture and/or skin drag) in the paraspinal tissues, and are excellent and reliable indicators of segmental facilitation at that level of the spinal cord. In a study of the palpatory findings in acute myocardial infarction, Nicholas and colleagues found increased temperature as the second most common tissue finding (2).

Viscerosomatic reflexes initially produce vague, midline, gnawing deep pain (Fig. 71.2). As they progress they involve neuromuscular changes in the segmentally related tissues; this reflex effect on muscle tone is important, as it identifies their spinal segmental level and distinguishes them at a paraspinal level (Fig. 71.3).In his work with Korr, Denslow describes "doughy, boggy" paraspinal myofascial tissues at the levels of facilitation (3). Patriquin describes a "fusiform soft tissue change in the paraspinal muscles" occurring over several segments which "tails out on the ends" (4). He continues to say, "the multifidus and rotatores are the best place in the spinal region to palpate for changes of viscerosomatic origin" (4). Beal, in his studies of cardiac and pulmonary patients, found a supine compression test to be the most accurate indicator of reflex dysfunction (5,6). Beal's description of the response to the compression test is at the level of joint motion, but is considered secondary to deep muscle splinting. Nicholas and associates, in a study of acute myocardial infarction, most often found "firmness" and warmth (2). Osseous/articular motion changes also occur, but these findings are most likely secondary to the altered muscle tone produced by the acute viscerosomatic reflex processes. William Johnston, DO, describes a "linkage" of thoracic vertebral and rib motion that he considers indicative of a viscerosomatic reflex (7). Once again, this articular motion finding is considered to be secondary to an altered neuromuscular response to a motion challenge. The movement restriction, found at a joint involved in this reflex process, is soft, with a springy feel, which, when palpated, suggests the viscerosomatic reflex. These regions also show unusual resistance to manipulative treatment, especially high velocity/low amplitude, when directed toward primary joint somatic dysfunction. Somatic dysfunction that rapidly recurs after "successful" manipulative treatment also suggests viscerosomatic origin or accentuation. When visceral inflammation involves the parietal peritoneum, the patient's discomfort becomes localized over the viscera involved (Fig. 71.4).

Acute segmental facilitation creates a variety of palpable tissue changes that may be used to identify the presence of an underlying disease process. The most superficial clues, temperature and skin drag or moisture, are among the most useful, and are easy to identify in the seated position. Palpation of the typical boggy, fusiform muscular changes can be performed with the patient either seated or supine. As with articular motion restrictions, viscerosomatic dysfunction is identified by motion restriction *without* a firm, stiff end-point but with a characteristic end-feel. It is likely that the differences between findings expressed by different examiners result from different diagnostic approaches.

The skills required to consistently identify reflexes develop with time and experience. For the practitioner learning to recognize the unique tissue changes of viscerosomatic reflexes, it is

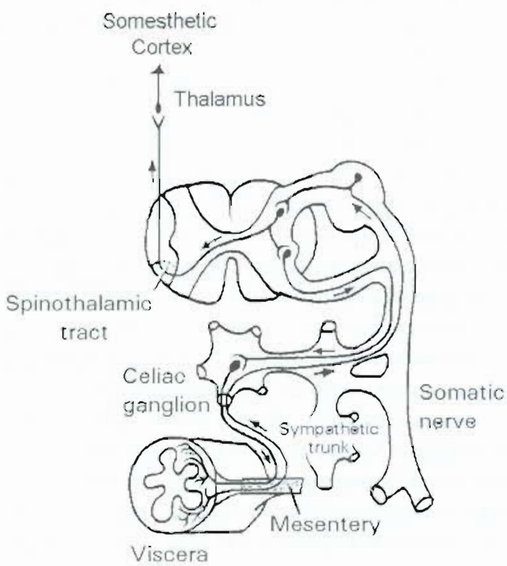

FIGURE 71.2. Visceral pain pathway—vague and periumbilical. Palpable tissue texture change is found in the abdomen over the prevertebral (collateral) sympathetic ganglion associated with that organ.

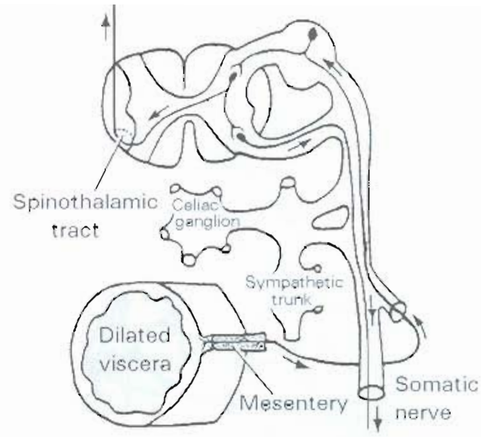

FIGURE 71.3. Viscerosensory pain pathway. This reflex produces the typical segmental viscerosomatic reflex. Palpable tissue texture changes are found over the somatic paravertebral tissues innervated by somatic nerves from the same cord level that supplies sympathetic innervation to the affected organ.

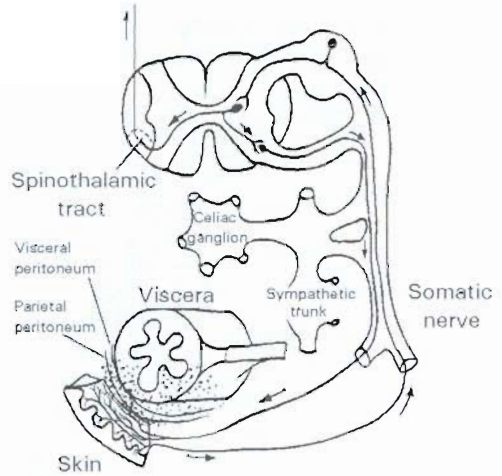

FIGURE 71.4. Peritoneal cutaneous reflex of Morley. The pain is localized over the viscera due to involvement of the parietal peritoneum directly over the organ. Palpable tissue texture change and acute pain is found directly over the organ and segmentally at the innervation level of the peritoneum or pleura.

TABLE 71.1. SEGMENTAL FACILITATION

Type	Characteristics
Acute	Increased temperature (a local chemical physiologic reaction), increased moisture and/or skin drag. Prolonged red reflex. Boggy, fusiform muscular changes. Articular motion restrictions *without* a firm, stiff end point.
Chronic	Thickened skin and subcutaneous tissues. Rapid fading red reflex. Localized muscle contraction (increased muscular tone). Muscles are hard, tense, and hypersensitive to palpation. Stiff joints with articular motion restrictions that are firm with more definite end-feel.
Acute on chronic	Warm, moist, and boggy superimposed on deeper hard, stiff tissues.

Nociceptive input from somatic tissue converges in the dorsal horn → Interneurons stimulate sympathetic efferents and α-motor neurons → Palpable somatic changes are produced.

helpful to evaluate reflex patterns in patients with clearly identified, acute disease processes. In this way the physician develops the skills required to recognize reflexes and to sense their unique qualities.

If a reflex persists, as occurs in a patient with a chronic disease, the tissues, including the joints, become stiff and the qualities palpated become different. Beal states, "The chronic phase of reflex activity is . . . characterized by trophic changes in the skin, increased thickening of the skin and subcutaneous tissues and localized muscle contraction. The muscles are hard and tense and may be hypersensitive to palpation" (8). The chronic muscle spasm ultimately stiffens the joints, giving the articular motion restriction a more firm, definite end-feel that is much closer to a typical postural or somatic problem. When someone with a chronic problem has an acute attack, a warm, moist, boggy tissue reaction will be superimposed on the deeper hard, stiff tissues, leading to a separate tissue diagnosis that may be called an acute on chronic problem. The tissues tell the story. This finding may be helpful in understanding the history of a current problem where the patient may be unaware of previous episodes of the problem (Table 71.1).

Interpretation of Findings

There is a tremendous amount and variety of information available to the osteopathic physician provided through the evaluation for the presence of segmental reflexes. Although practice will obviously improve the accuracy of the examination, 10 years of experience doing structural examinations in the acute care setting has demonstrated to this author that the great majority of cases present with significant, obvious reflex patterns which are easily recognized.

1. *The presence or absence of an acute process* (perhaps the most fundamental difference). Although this information alone should not determine workup and treatment, it can be a factor in how aggressively a patient should be worked up, especially with a somewhat vague complaint. The presence of an acute reflex indicates an underlying acute process. For example, a right lower quadrant abdominal pain, appendicitis, a ruptured ovarian cyst, or Crohn disease will all produce an acute reflex pattern. Simple cramping or mild gastroenteritis will not.

2. *Identification of visceral disease in the presence of an acute reflex finding.* There are some diseases that may be differentiated by localization of reflexes and some that may not. For example, the heart is innervated by levels T1-5, whereas the stomach is innervated by levels T5-9. Although there is anatomic variation within these levels, it is usually clear if substernal pain has its origin in the heart or the stomach. On the other hand, the gallbladder and the duodenum are both innervated via the right side of the celiac ganglion, and cholecystitis and duodenal ulcer would produce a similar, if not identical reflex pattern. Although many sources identify unique sympathetic innervation levels for each viscus, clinically there are four important groupings which are easy to remember and practical for use (Fig. 71.5).

All structures above the diaphragm are innervated (approximately) by the T1-5 levels. This includes the heart, lungs (often extended to T6 or T7 in the literature), esophagus, and viscera of the head and neck. A vast majority of cardiac problems occur on the left side (left ventricle), and these problems would produce a left-sided somatic reflex. Spinal roots T5-9 (approximately) transmit and receive via the pathway of the greater splanchnic nerve primary sympathetic fiber synapse in the celiac ganglion. The liver, gallbladder, duodenum, and pancreas (head) are innervated from the right side at these levels. The stomach, spleen, and pancreas (tail) are innervated from the left. The inferior border of the scapula can help a physician identify this general spinal region in the seated patient. Spinal roots T10-12 (approximate) transmit and receive via the lesser splanchnic nerve pathway and primary sympathetic fibers synapse in the superior mesenteric ganglion. It should be remembered that these spinal levels include the innervation of kidneys and upper part of the ureters, testes, ovaries, and upper part of the fallopian tubes, as well as the entire small

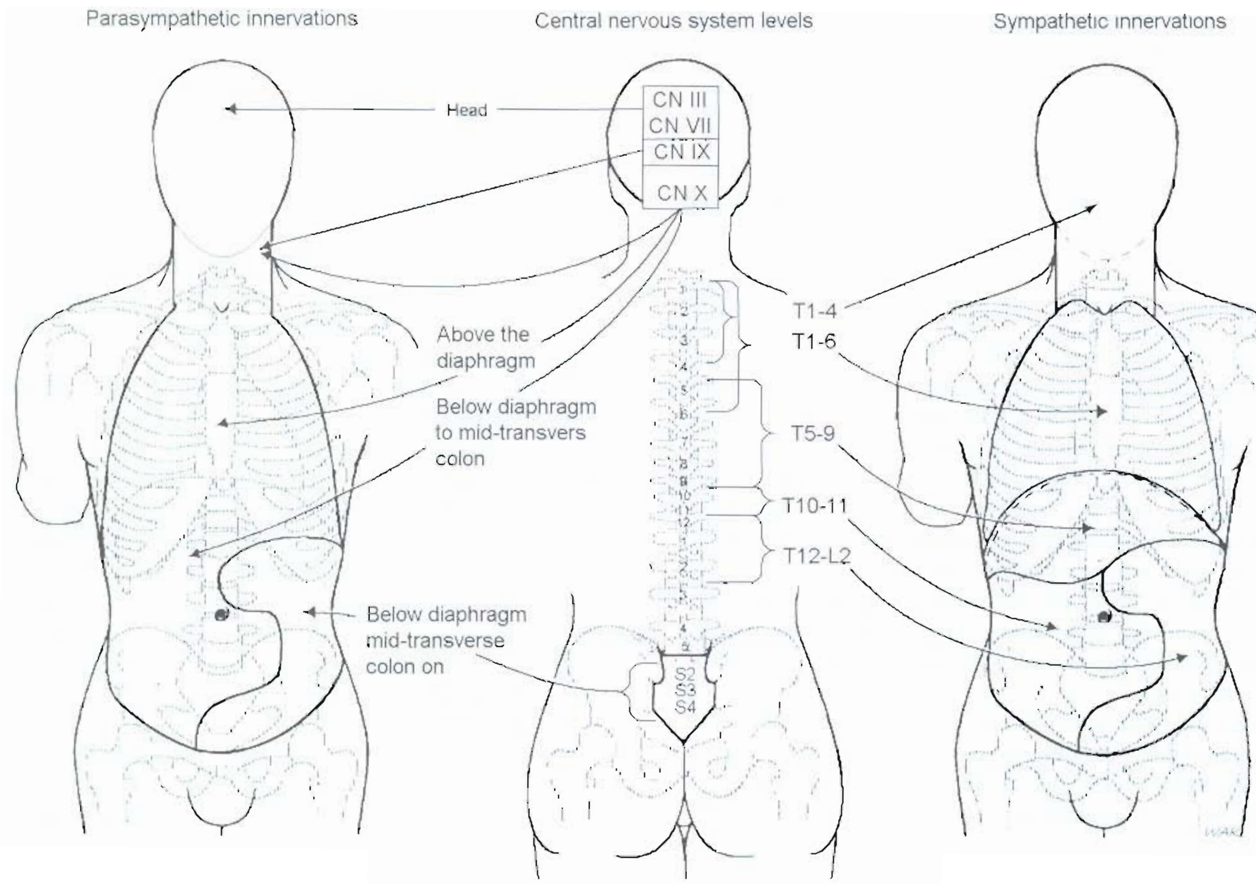

FIGURE 71.5. Sympathetic and parasympathetic innervations.

bowel, ascending colon, and transverse colon to about the splenic flexure (including the appendix). Right-sided organs, including the appendix, cecum, and ascending colon have a right-sided innervation. The T10-11 spinal region is contacted by placing one hand on the spinal region just posterior to the xiphoid process and extending caudad. Spinal roots T12-L2 innervate the lower abdominal and pelvic viscera. Fibers travel in the pathway of least splanchnic nerve and primary sympathetic fibers synapse in the inferior mesenteric ganglion. This level also innervates the lower part of the fallopian tubes and the lower part of each ureter, as well as the uterus (prostate in males) and bladder. The colon here has a left-sided innervation so irritations would produce left-sided paraspinal somatic reflexes. The 12th rib is useful in differentiating the middle from lower abdominal levels. The T12-L2 region can also be approximated by putting one hand over the spinal region at the level posterior to the umbilicus and extending it cephalad.

It is suspected by this author that variations recorded between organs within the same general level may have more to do with individual variation of the populations investigated than with consistent differences in actual innervation. Regardless, this author does not believe it is clinically possible to differentiate between different viscera within a given level if their innervation comes from the same side. Furthermore, grouping the viscera by general level is easy to remember and is clinically useful. In this scheme, it is impossible to distinguish appendicitis from a right-sided ovarian cyst, but appendicitis can be differentiated from cholecystitis or a left-sided ovarian cyst with a midline pain presentation. Early visceral pain is referred to the midline of the abdomen, often around the umbilicus. It is a good idea to have some way of recalling the basic autonomic innervation to the viscera of the body (Fig. 71.5).

3. *Assessing degree of disease by degree of reflex facilitation.* This is an intriguing thought, but an ill-advised one. Different individuals have different reactivity within their nociceptive nervous systems, and will therefore present with varying degrees of reflex facilitation with the same degree of inflammatory process and/or disease. One particular example from clinical practice would be the patient with diabetic neuropathy, which affects small caliber peripheral nerves. These patients often have blunted reflexes that are more difficult to identify and interpret. Once a baseline level of dysfunction is established, and compared to other clinical indicators of disease severity, it may be possible to follow the progress of the disease by changes in the intensity of the reflex, although this has not been studied. However, it is not uncommon to find a reflex has changed or disappeared, indicating a change in the patient's clinical status before other indicators have changed.

4. *Differentiating acute versus chronic processes.* This can be important in several ways. First, it may allow the identification of a long-standing process in the face of an acute presentation (i.e., the "acute on chronic" tissue changes). Surprisingly, patients do not always recall past episodes of a problem. The examiner can

also identify if a known chronic problem is, in fact, the cause of a present complaint. A chronic reflex pattern, without an acute overlay in that region makes it is unlikely that the chronic organ or system is the source of the acute disease process. This might be useful in the evaluation of chest pain in a patient with a history of ischemia or myocardial infarction, who will undoubtedly demonstrate chronic findings with or without an acute process superimposed.

The Thorax

Breathing is one of the most fundamental processes in human physiology. Respiration is responsible not only for the movement of air, but is also directly involved with venous and lymphatic circulation. A focused evaluation and treatment of the thorax is indicated in all respiratory diseases, such as asthma and pneumonia. Thoracic function also has an impact in less obvious situations, such as the postoperative abdominal surgery patient, whose most likely complication will be pulmonary, or the lower extremity cellulitis patient, whose body depends on diaphragmatic respiration for proper drainage of the infection. There are few, if any, acutely ill patients who do not warrant a focused examination of their respiratory mechanism.

The structural examination of the thorax can reveal a great deal about the underlying condition of the respiratory system. Breathing may be divided into an inhalation and exhalation phase. Restricted motion in one phase may suggest one pathology over another. Pneumonia will reduce the excursion of the thorax toward inhalation locally, over the area of consolidation, whereas asthma and other obstructive diseases will reduce the excursion of the thorax toward exhalation. This finding may help differentiate the patient with a primary asthmatic attack from one whose asthmatic attack was triggered by pneumonia. The difference between restricted inhalation and exhalation may also help differentiate chronic obstructive pulmonary disease (COPD) from congestive heart failure (CHF), which often coexist in the same patient, and may present similarly with shortness of breath and crackles in the lung bases. If the present exacerbation is due primarily to CHF, there will be restriction of the lower thorax to inhalation, and the exhalation phase will be relatively effortless. If the present exacerbation is COPD, the patient will have dramatic limitation to exhalation and the exhalation phase will be active (the patient will work to get the air out). This effort by the patient is easily observed by placing the fingerpads or palm in contact with the patient's skin, just below the costal margin.

Structural examination of the thorax should be performed along with auscultation and percussion in the physical examination of the cardiac and respiratory systems. The structural examination includes evaluation of the entire spine, the pelvis, and sacrum, which move, in addition to the ribs, during respiration and contribute to the overall shape change of the thoracic cavity (9,10). The excursion of the thorax produces the volume and subsequent pressure changes that produce the movement of air and fluids.

Compliance of the thorax is a separate, important functional parameter of respiration related to the structural evaluation of respiration, as it more accurately reflects the work of breathing, especially in obstructive and restrictive pulmonary disease. The clinical difference between excursion and compliance may be understood by comparing the difference between an otherwise healthy patient with COPD, who will have a limited but adequate excursion of a very stiff, noncompliant thorax, to a patient with no preexisting pulmonary disease going into acute respiratory failure due to exhaustion of the respiratory musculature. The latter patient will have a very limited excursion of their thorax, but may have a compliant spine and rib cage. Comparing excursion (by monitoring movement during respiration) to compliance (by motion testing the spine and rib cage) will yield a much more complete picture of the respiratory system than reviewing either of these factors alone.

The length and tone of the respiratory musculature, including the diaphragm, will complete the structural examination of the respiratory system. Evaluate the muscles, both during contraction (inhalation) and at rest (end exhalation). Evidence of respiratory muscle fatigue and failure should be obtained during this part of the examination. Intercostal retractions may be observed during the evaluation of rib excursion. Paradoxic motion of the lower ribs (inward movement during inhalation), an indicator of a flattened, tense diaphragm, may be observed during evaluation of the excursion of the lower rib cage. Paradoxic movement of the abdomen (inward movement of the abdomen during inhalation), a sign of impending respiratory failure, may be observed with a hand below the costal margin. A less obvious sign of diaphragm fatigue may be noted with the same contact, as the effort or force of contraction during inhalation will be reduced as the diaphragm fatigues.

Focused Structural Examination of the Thorax

This is also discussed in Chapter 49, Ribs and Sternum.

Upper Thorax

1. *Sternum.* Evaluate movement of the sternum, both inhalation and exhalation.
2. *Clavicle.* Evaluate a sense of posterior/superior movement of the clavicle with inhalation, and an anterior/inferior movement during exhalation. Also evaluate inferior movement at the sternoclavicular (SC) joint during upward shrug of the shoulders and its relative superior movement during return to resting state. Evaluate rotation on its long axis during forward flexion of the shoulder. Palpate for a normal slight movement of the acromioclavicular (AC) joint during adduction of the arm across the chest. Test for hinge motion of the sternomanubrial joint during inhalation and exhalation.
3. *First rib.* Evaluate when examining the clavicle.
4. *Ribs 2 through 6.* Evaluate pump handle motion of the upper ribs with hands lateral to the sternum; evaluate middle ribs with thumbs approaching the xiphoid and fingerpads over the midaxillary line; evaluate bucket handle motion with hands below the breasts (see Chapter 49, Fig. 49.8).
5. *Musculature.* Evaluate the tension of the scalene, sternocleidomastoid, and trapezius muscles when evaluating the clavicle and first rib. Evaluated the intercostals when evaluating rib motion. Evaluate the paravertebral musculature, particularly those with rib attachments.

Lower Thorax and Diaphragm

1. *Ribs 6 through 10.* Evaluate bucket handle motion at the mid-axillary line, thumbs along the costal margin to evaluate any degree of AP motion.
2. *Costal margin.* Rest thumbs along costochondral margins. Evaluate angle and motion.
3. *12th rib.* Most easily found just lateral to the lateral edge of the erector spinae musculature. Compare the right and left 12th rib angles and motion and note that it should move down with inhalation as opposed to other ribs that move up with inhalation.
4. *Diaphragm.* Direct palpation of the diaphragm can be difficult due to its position under the rib cage. Its motion can be evaluated in several ways.
   a. With a hand just below the costal margin, the superior/inferior motion of the anterior and lateral parts of the diaphragm may be evaluated. This will allow evaluation of the anterior and lateral aspects of the diaphragm, but will not yield information about the posterior aspect. These regions do not necessarily operate together, as in the vomiting reflex, where the anterior and lateral contractions produce the forces for regurgitation; simultaneously the crura must relax to maintain patency of the gastroesophageal junction. The motion of the diaphragm should be differentiated from the motion of the abdominal wall.
   b. The motion of the 12th rib closely parallels the excursion of the posterior part of the diaphragm.
   c. The lumbar spine will reflect the tension in the posterior aspect of the diaphragm through the attachment of the crus to the first three lumbar vertebrae. When tense, the crura will flatten the upper lumbar vertebra. This will be noted as flattening or reversed lordosis statically, and resistance to upward spring or compression, at levels L1-3. This is easily accomplished with the patient in the supine position.
   d. With a hand above and below the lower thorax, the superior/inferior motion of the diaphragm may be distinguished from the lateral excursion of the ribs.

The Abdomen

Evaluation of the container should accompany the classic palpatory evaluation of the abdomen. The shape of a container will affect the function of its contents. The abdomen has a roof, a floor, and anterior and posterior walls.

- The *diaphragm* is the roof of the abdomen; the liver, spleen, and supporting mesenteries are suspended from it.
- The *pelvic diaphragm* is the floor. It, along with the shelf created as the posterior abdominal wall crosses the pelvic brim at the level of the pectinate line, and supports the abdominal and pelvic viscera from below.
- The *iliopsoas and quadratus lumborum* make up the posterior abdominal wall. The insertion of iliopsoas on the lesser trochanter of the femur involves the hip in abdominal and pelvic function.
- The *abdominal wall* is its anterior boundary.

Skeletal Considerations

The sacrum, pelvis, hip joint, lumbar spine, and lower six ribs and thoracic vertebrae form the structural and functional framework to which the soft tissue container of the abdomen is attached and supported. All should be evaluated for motion restriction and/or altered position.

The diaphragm should be evaluated with emphasis on its lower attachments to the 12th rib and lumbar spine. When the diaphragm becomes tense it flattens and carries the 12th ribs inferiorly at their tips. The lumbar spine will become flattened and resist anterior pressure in the supine patient. The same relative positions will be adopted when the diaphragm has a fascial "drag" placed on it, although the resistance encountered will be of a lesser degree and different quality. Rarely will the diaphragm be displaced superiorly from a dysfunction.

The movement of the pelvic diaphragm may be inferred by the magnitude and intensity of the consequent nutation/counternutation movement of the sacrum occurring during respiration (see Fig 71.13). Although this movement may be more obvious with the patient prone, supine evaluation is often necessary in the acutely ill, hospitalized patient. A two-handed contact from the side of the patient, one hand contacting the sacral base and the other on the sacral apex may be used for this evaluation. More direct evaluation of the tension and movement of the pelvic diaphragm may be performed with a contact in the ischiorectal fossae. These are found just medial and slightly posterior to the tip of the ischial tuberosities (Fig. 71.6). The pelvic diaphragm will move inferiorly with inhalation and superiorly with exhalation.

The quadratus lumborum may be palpated anterior and lateral to the erector spinae mass in the lumbar spine. Its edge is usually discernible beginning just below the tip of the 12th rib. The psoas major is a deeper, more medial flank muscle that is more difficult to palpate directly. The increased amount of muscle tone observed and the combination of upper lumbar somatic dysfunction and external hip rotation on the same side may infer tension. The tendon of the iliopsoas is directly palpable just below the inguinal ligament in the floor of the femoral triangle. The iliopsoas tendon is usually tense, full, and tender when the muscle is in spasm. One can often sense the tension in the entire iliopsoas with one hand contacting the tendon in the femoral triangle and the other under the upper lumbar attachments. Only the iliopsoas travels anteroinferolaterally here. Jones has also described anterior abdominal tender points related to spasm of the iliopsoas muscle (see Chapter 73, Counterstrain).

Palpation

Palpation is an essential part of any abdominal examination. However, extra care must be taken to avoid exacerbation of the patient's pain, as the resultant guarding by the patient will interfere with the examiner's ability to gather reliable information.

Light Palpation

It is useful to begin the abdominal examination with light palpation and in a region of the abdomen distant to the patient's chief complaint of pain or discomfort. This will help secure the

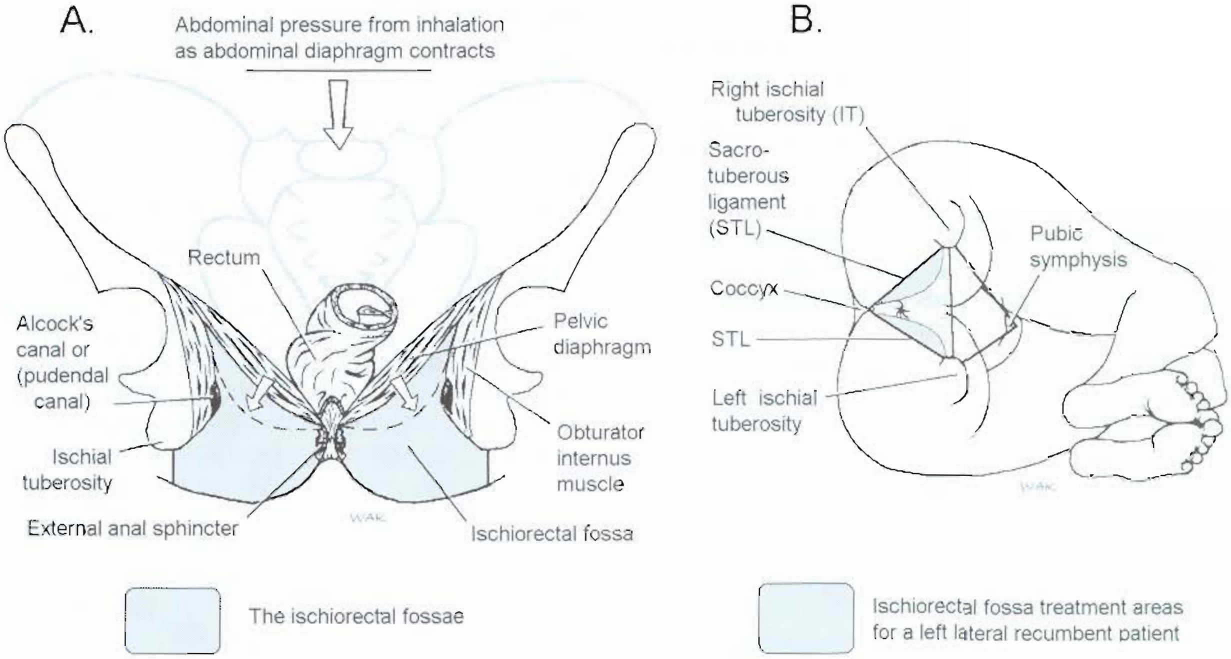

FIGURE 71.6. The ischiorectal fossa and pelvic diaphragm. **A.** The broken line depicts the pelvic diaphragm during inhalation. **B.** The ischiorectal fossa as it would appear in a lateral recumbent patient.

patient's comfort and cooperation, and can yield information not obtainable with deep palpation.

1. *Involuntary guarding by the patient.* Involuntary guarding, present without any actual or perceived stimulation of the discomfort, should be distinguished from voluntary guarding due to actual or perceived exacerbation of pain induced by the examination. This determination is an essential part of the abdominal examination, and is most accurately evaluated with light palpation, as many healthy individuals will guard with deep palpation.

2. *Ptosis.* Dr. Still often taught that there is a sag of the abdominal contents into the pelvis resulting in physiologic consequences. He wrote, "The caecum and the transverse and sigmoid flexure are often forced from their normal positions and piled into the pelvis, dragging the uterus and small intestine down with the caecum and obstructing all possible chance for the fluids of the small intestine to pass through the ileocecal valve and reach the colon" (11). Sag of the abdominal contents and the mesenteries that support them may be evaluated by comparing the resistance to normal limits and with the right and left sides, produced by a gentle lift just superior to each inguinal ligament. This quick test should be part of the light palpatory examination.

3. *Congestion.* A sense of fullness and or congestion will often be evident over areas of acute inflammation, such as cholecystitis or diverticulitis. It may be accompanied by a palpable sense of warmth. This somewhat subtle finding will be much more difficult to identify during deep palpation. There may also be a subcutaneous puffiness palpable over the epigastric region of the abdomen, a terminal drainage site related to the abdomen.

4. *Tenderness.* Tenderness is a subjective symptom but can usually be identified accurately during light palpation. Identifying the tender area early in the examination and leaving that area for evaluation near the end of the examination will help maximize patient cooperation for the bulk of the early abdominal examination. The area of the patient's tenderness can be evaluated in depth at the end of the abdominal examination.

Deep Palpation

Deep palpation must be carefully performed. Slow, deliberate movements will minimize discomfort and voluntary guarding. Never palpate with your fingertips. Use the fingerpads.

Palpation with one hand over the other may be more comfortable to the patient and enhance palpatory sensing. The fingerpads of a relaxed hand rest on the patient and receive information while the other hand, resting on top, exerts gentle, steady pressure to reach the desired depth. The abdomen is classically divided into four quadrants for palpation (see Chapter 51, Fig. 51.11). The epigastrium and suprapubic areas may be considered separately. The examiner should always keep a clear mental picture of all significant anatomic structures in the area being palpated (see Fig. 51.12). Although many viscera are not palpable in normal conditions, in pathologic situations they may become discernible and offer clues to an accurate working diagnosis. Several examples, that this author has been found to be useful in practice, are presented, but the possibilities of abdominal palpation are far greater than just these examples.

1. The tip of the gallbladder capsule is often palpable in cases of acute cholecystitis, with associated fullness, congestion, and often warmth overlying it. When present, these signs are more accurate than the Murphy sign of right upper quadrant tenderness.
2. The stomach is palpable slightly left and inferior to the xiphoid. Sometimes the physician will note that the stomach resists gentle downward distraction produced with one hand, while the other hand contacts the xiphoid to stabilize the

diaphragm. This resistance is consistently present in patients with hiatal hernia and reflux disease. Fullness, congestion, and warmth are often present in the left upper quadrant in acute gastritis.

3. The motion of the liver with breathing and the tension within the ligaments anchoring the liver to the diaphragm should be evaluated, along with the size and contour of the liver. The movement of the diaphragm is essential for efficient portal circulation (12).

The Fluid (Lymph) Mechanism

The evaluation of the body's circulatory system is an integral part of any physical examination. The evaluation of the status of the lymphatic circulation is indicated in any inflammatory process, as the lymphatic system is responsible for the drainage of inflammatory exudates, and is integral in the progression and resolution of an inflammatory process. Millard was the first osteopathic physician to discuss the evaluation of the lymphatic system in the physical examination. He said, "For every congested tissue there is a corresponding lymph disturbance. Wherever pus is present there is enlargement in the nearest nodes. The lymph stream ebbs and flows according to the amount of blockage and nodular involvement at certain points" (13). Dr. Millard considered it possible to differentiate disease processes by the location, degree, and quality of lymph node enlargement. He also described a principle that is important in the treatment of lymph congestion: "The lymph stream is readily checked in many ways. The lymph vessels are pliable and readily compressed" (13). In the evaluation of lymphatic function, one must investigate tissue tension along the course of lymphatic drainage, with an emphasis on the regions where lymph vessels are most vulnerable to altered tissue tension.

J. Gordon Zink, a student of Dr. Millard, continued to develop methods for the evaluation of lymph function and dysfunction. He called attention to the congestion produced in the regions of lymph nodes when there was dysfunction of the lymph system, with or without frank edema, and the supraclavicular congestion found with dysfunction of the thoracic duct and "terminal lymph drainage from the head and neck." He also described a specific test he used in the evaluation of the lymphatic system. "There is a simple but very practical test to confirm better circulation, because of restored diaphragmatic respiration, when the patient is supine. The hands of the physician are placed high on the patient's abdomen, just below the costal arch. Firm pressure is used downward toward the table and cephalad, as if to 'raise' or 'redome' the diaphragm. The patient should experience a sensation of 'warmth' or 'heat' in the lumbar and sacral area" (10).

W.G. Sutherland introduced the concept of fluid fluctuation in his description of the primary respiratory mechanism (14). The movement of interstitial fluids is important in the process of cellular respiration (the cellular exchange of gases), as well as the exchange of nutrients and waste products. Motion of the interstitial fluids occurs in response to intrinsic, rhythmic motions of the body, including pulse, respiration, and the primary respiratory mechanism. Interstitial fluid fluctuation may be evaluated passively, by the presence or absence of these inherent forces in the region of the body being evaluated. They can also be actively evaluated by assessing the response of the tissue and its fluid matrix to local or general lymph pump techniques aimed at fluctuating the interstitial fluid. The evaluation of the static and dynamic findings of the lymphatic circulation is important in the overall physical evaluation of the circulatory system (Table 71.2).

APPROACHING THE ACUTELY ILL HOSPITALIZED PATIENT

Osteopathic treatment in the hospital setting is most effective when it addresses underlying physiologic mechanisms of the disease and supports the physiologic response of the host who has the disease. Although the manipulative treatment is ultimately based on the findings of the structural examination, these findings should be interpreted with regard to the body's response to the disease process and directed toward supporting the body's physiologic processes. This section will present a variety of conceptual models from which treatment plans should evolve. Techniques will be described to provide examples of how some of the underlying principles may be achieved, but should not be construed as the best or only way to treat an area or problem. One cannot overemphasize the importance of designing treatments to the individual. There is, therefore, no such thing as a technique for asthma, congestive heart failure, or any disease, nor is there a manipulative technique for reducing segmental facilitation, improving respiratory/circulatory function, or any other physiologic process. A variety of techniques can be employed for any of these treatment goals. Any technique is appropriate if it addresses the underlying physiology and mechanics, is appropriate for the present condition of the patient, and brings about the changes a physician expects to see from application of an efficient treatment to accomplish a specific physiologic goal.

Inflammation

Inflammation is the generalized response to injury and disease. It is the hallmark of most acute illnesses. Inflammation involves the vascular system, the immune system, the nervous system, and the connective tissues. It is essential to the initial response of the body to the disease process, as well as the healing process. The lymphatic system is an integral part of the progression and ultimate resolution of inflammation. Besides draining areas of infection and injury, lymphatic drainage carries antigen to the nodes, where immune stimulation takes place and T and B cells are produced. Nodal efferents provide migration routes for these cells to enter the primary circulatory system.

The lymphatics are the only vascular system permeable to large particles, fats, and protein. In normal function, the lymphatics remove the proteins, which leak into the interstitium from the capillaries, maintaining a delicate osmotic balance, and keeping the interstitial environment pristine. During any inflammatory process, increased capillary permeability allows a tremendous efflux of protein into the interstitial spaces, producing an exudative swelling. This exudate can only be drained through the lymphatics. In addition, there is evidence that lymphatic drainage is necessary for the removal and deactivation of the chemical and immune mediators, which control inflammatory processes, making the lymphatics central in the progression and resolution of the

TABLE 71.2. CLINICAL PEARLS

Patient		Findings
Compare:	1. Paradoxic movement of lower ribs 2. Paradoxic movement of abdomen	1. Inward movement of these ribs during inhalation; indicates *flattened tense diaphragm* 2. Inward movement of abdomen during inhalation; indicates *impending respiratory failure*
Compare:	1. Sign of impending respiratory failure 2. Sign of a *flattened, tense abdominal diaphragm*	1. Paradoxic movement of abdomen during breathing 2. Paradoxic movement lower ribs
Compliance of the rib cage		The ease with which the rib cage will move
Compare:	1. *Poor excursion* 2. *Poor compliance*	1. Evaluated by movement of the rib cage during breathing (i.e., poor observed motion) 2. Evaluated by motion testing of rib cage and sternum (i.e., poor motion tests)
Sign: abdominal *diaphragmatic fatigue*		Force of diaphragmatic contraction is reduced during inhalation
Compare:	1. Paradoxic movement lower ribs 2. Paradoxic movement of abdomen	1. Dramatic limitation of exhalation; patients uses active effort to exhale 2. Restricted lower rib cage during inhalation; relatively free exhalation
Compare:	1. *Congestive heart failure* patient 2. *Chronic obstructive pulmonary disease* patient in relatively good health	1. Poor excursion; poor compliance 2. Limited excursion but often spine and rib cage compliant
A manipulative technique is appropriate when:		1. It addresses the underlying physiology and mechanics 2. It is appropriate for the present condition of the patient 3. It brings about changes expected when applying efficient treatment to accomplish a specific physiologic goal
The work of breathing		A quantitative measure of the energy required by the body to overcome the resistance of the lung parenchyma and chest wall and accomplish inhalation and exhalation
35% to 60% of thoracic duct lymphatic flow is due to:		The response and effects of respiratory movements

process itself (15–18). Diseases including pancreatitis, asthma, rheumatoid arthritis, and even myocardial infarction will depend on lymphatic drainage for resolution.

The large efflux of protein and water from the capillary bed leaves a very high concentration of erythrocytes, which pack into the small venules producing local venous stasis (17). This makes the lymphatic system the only source of fluid drainage from an inflamed tissue. The tissue becomes saturated when the small hydrostatic gradient that produces capillary filtration is met by the increased interstitial pressure that the swelling tissue produces. At this point, the rate of blood supply will equal the rate of lymphatic drainage.

Inflammation and healing are aspects of one continuous process, guided by the same group of cells. Cellular activity will shift from proinflammatory to healing as the proportion of relative controlling mediators shift their activity. Although this progression is related to the production of mediators, one must consider the role of the efficient breakdown and removal of these mediators in the progression and resolution of any inflammatory process. Prolonged inflammation leads to poor healing, smoldering infections, chronic inflammatory processes, and eventually tissue destruction. There is evidence that lymphatic drainage is involved in the removal and breakdown of histamine, bradykinin, prostaglandins, and leukotrienes (including cytokines). Other mediators or the fate of other mediators simply have not been studied.

As proinflammatory mediators are removed, those that stimulate fibroblasts and macrophages will predominate, and the healing process will ensue. Residual (interstitial plasma) protein from the inflammatory exudate will also stimulate fibroblasts to produce collagen. As with the inflammatory phase, rapid and efficient removal of these elements is essential to a physiologic healing process. A prolonged healing phase will lead to excess collagen production, fibrous adhesions, and eventually to tissue fibrosis. The lymphatic system is responsible for the removal of most, if not all, of the inflammatory exudate. It has been shown that lymphatic drainage is involved with controlling the rate of collagen production, both during the healing process and in the pathogenesis of diseases that result in tissue fibrosis. Diseases such as cirrhosis of the liver, interstitial lung diseases, and atherosclerosis have been linked to impaired lymphatic function (19).

The lymphatic system is vulnerable to somatic dysfunction and its dysfunction is responsive to osteopathic manipulative treatment. The function of the lymphatic system should be evaluated and treated as part of the osteopathic treatment of any patient with an inflammatory process.

Segmental Facilitation

The treatment of acute segmental facilitation is fundamental and a broadly applicable model for the treatment of virtually any acutely ill patient. Reflex facilitation occurs in response to a vast majority of disease processes, and can alter and/or exaggerate the body's response to the disease, interfering with the recovery process. Facilitation is produced by nociceptor input, so that diseases presenting with pain are the most likely to produce significant reflex patterns. Van Buskirk notes that the spinal cord may be activated at a lower level of firing than is necessary to activate the cortex and produce pain perception, so the perception of pain is not necessarily required for a reflex to be present (20). Inflammation has been shown to greatly increase the firing of nociceptors. Therefore, those diseases that involve inflammation and/or a very tense patient are also likely to produce reflex facilitation, with or without the perception of pain (21). The effects of segmental facilitation will vary depending of the spinal cord levels involved and/or the organ systems involved in the disease process.

The heart is extremely responsive to its innervation. Reflexes in the region of the sympathetic innervation of the heart have been shown to occur in ischemic heart disease and acute myocardial infarction (2,6). Increases in sympathetic outflow will increase heart rate and contractility, while simultaneously constricting the coronary vessels, reducing blood flow to the heart. This can produce an increased discrepancy between oxygen demand and supply available to a patient with coronary artery disease or to the ischemic portion of the heart after acute myocardial infarction. Segmental facilitation may also increase the arrhythmogenicity of the heart, a potentially devastating occurrence following a myocardial infarction. Talman writes, "Parasympathetic influence tends to stabilize and adrenergic stimulation tends to increase the ventricle's propensity to develop arrhythmias. Asymmetrical sympathetic activity, particularly that which favors the left-sided sympathetic pathways to the heart, is especially arrhythmogenic" (22). The left-sided, upper thoracic segmental facilitation noted in response to acute myocardial infarction will produce an increase adrenergic influence to the heart that favors left-sided innervation. Finally, Korr noted other, less obvious effects of increased sympathetic activity to the heart, including a prolonged healing time and reduced production of collateral circulation (23). Both are important in the recovery period following a myocardial infarction.

The heart also has a parasympathetic innervation via the vagus nerve. The vagus nerve will reduce heart rate and contractility, and carries information via the baroreceptors concerning blood pressure. Beal reports a less common cervical finding associated with cardiac disease that may reflect a reflex carried by the afferent fibers of the vagus nerve (6). It has been found that firing vagal afferent fibers stimulates the C1 and C2 segments of the spinal cord (24). Kuchera and Kuchera suggest that vagal sensory innervation of the heart is concentrated in the posterior and inferior walls, which explains the greater number of bradyarrhythmias from those infarctions (25). Although this idea has had little study, Rosero and colleagues did find a reduced correlation of upper thoracic somatic dysfunction with posterior/inferior wall myocardial infarction (26). His study did not look at the presence of cervical findings in these patients. The presence of upper cervical and cranial (especially occipitomastoid) somatic dysfunction should be treated in patients with cardiac disease, especially in the presence of a bradyarrhythmia (right vagus) or atrial ventricular block (left vagus). Reducing segmental facilitation in patients with acute cardiac disease is central to the osteopathic treatment of their cardiac processes. However, extreme care must be taken in the treatment of acute cardiac patients, as the heart is extremely sensitive to changes in autonomic firing, which may occur during the treatment if appropriate caution is not exercised. Techniques that have been found safe and effective are described in the treatment portion of this chapter.

The response of the lungs to the autonomic nervous system is important in a variety of disease processes. Vagal activity is related to the bronchospasm and mucous production in the pathophysiology of asthma. As stated previously, the vagus reflexes with the spinal cord at the C2 level. C2 somatic dysfunction has been consistently noted in diagnostic studies of pulmonary disease (8). Ipsilateral cranial base dysfunction, in particular that of the occipitomastoid articulation, usually is associated with vagal type reflexes. The sensory ganglion of the vagus nerve lies within the jugular foramen, adjacent to the occipitomastoid suture. Though the cervical findings are reported less often than the upper thoracic findings, this may be because the vagus and other parasympathetic nerves will not vasodilate or stimulate sweat glands, producing the associated temperature and skin moisture changes that are among the most common recognizable signs of acute segmental facilitation. It is therefore possible that segments facilitated in areas of parasympathetic innervation are underrecognized. Upper cervical findings in pulmonary disease, especially asthma, may be the most significant structural findings, due to the pathologic effects of segmental facilitation of the vagus nerve in this disease. Wilson also noted that, in asthmatic patients, he consistently found right paraspinal changes at T4-5 and somatic dysfunction of the right fourth or fifth rib (27). He reports significant improvement in acute asthmatic attacks following manipulative treatment of these dysfunctions. Asthma, an inflammatory disease, usually produces a more significant reflex at these levels than COPD.

Recognizing the role of the vagus nerve in producing bronchospasm and secretions, reflex facilitation of the vagus from somatic dysfunction at C2, the occipitomastoid suture, and/or the cranial base will exaggerate the degree of bronchospasm and secretions. Reducing the segmental facilitation may raise the threshold necessary for production of an asthma attack, reduce the need for medication, especially bronchodilators that are prone to overuse, and help reduce the severity of an acute attack. Vagal reflex somatic dysfunction should be identified and treated in patients with pulmonary diseases.

A different type of reflex is present in pneumonia. Pneumonia is accompanied by a local reduction in rib excursion. This dysfunction pattern is described in standard physical diagnosis texts, as well as osteopathic literature (25,28). This phenomenon cannot be a typical viscerosomatic reflex, since the dysfunction levels in lower lobe pneumonia are outside the levels of the sympathetic innervation of the lung. It is more likely they are produced through the parietal pleura, which carries a local, intercostal innervation. These reflex changes are likely involved in the pleuritic chest pain (Fig. 71.4) which often accompanies pneumonia, and are very useful in locating and making the diagnosis of pulmonary consolidation. Treatment of these reflex changes is important in the overall treatment plan of patients with pneumonia.

Upper thoracic findings associated with pulmonary disease (T1-5, and occasionally T6) are commonly found in patients with acute and chronic bronchitis. This is consistent with the notion that the sensory innervation of the large airways travels mostly via the sympathetic nerves, while the sensory innervation of the small airways (asthma, lobar pneumonia) travels predominantly via the vagus. While sympathetic outflow may not be as detrimental to pulmonary function as vagal, the associated thoracic segmental spinal facilitation and somatic efferent outflow results in restriction of the upper ribs, reducing the ability of the patient with bronchitis to expectorate secretions. Somatic dysfunctions in these patients should be treated with osteopathic manipulation.

The gastrointestinal (GI) system has an extensive autonomic innervation, which is involved in a variety of disease processes. The vast majority of nociceptors from the GI tract travel with the sympathetic nervous system, producing reflex somatic dysfunction at approximate spinal levels from T5-L2. Cervical findings are absent in diagnostic studies involving GI diseases (8). Increased sympathetic outflow can have a multitude of detrimental effects on patients with GI diseases. The sympathetic nervous system reduces blood flow to the entire GI tract, making recovery from virtually any problem more difficult. The other major effect of the sympathetic nervous system is to reduce GI motility. This effect may be most noticeable in postoperative ileus, a common complication of abdominal surgery. The skin carries the highest concentration of nociceptors of any tissue in the body. Therefore, the patient, whose dermatomes are affected by a midline incision from the xiphoid to pubes, will have the possibility of having nociceptive reflexes to the entire T5-L2 spinal region. This is also the segmental site for sympathetic innervation of the entire GI tract. The bilateral segmental facilitation produced by a surgical abdominal incision, particularly a large midline incision, can significantly delay the body's ability to return to normal GI motility following abdominal surgery. Osteopathic treatment to reduce segmental facilitation is indicated following abdominal surgery, and in any case of paralytic ileus. Normalization of the sympathetic nervous system by ileus prevention manipulative treatment given before abdominal surgery has been shown to reduce the incidence of paralytic ileus. Alteration in GI motility is also a major part of the pathophysiology of irritable bowel syndrome. Osteopathic treatment to reduce reflex facilitation is indicated in these patients as well.

The sympathetic nervous system also affects the sphincters of the abdominal viscera. This can have an adverse effect in a number of situations. Cholecystitis accompanied by a stone lodged in the common bile duct will produce a reflex in the T6-9 region on the right. This is the origin of the innervation of the ampulla of Vater, whose tone will be increased by the segmental facilitation resulting from this pathophysiology. This, in turn, makes the passage of the stone more difficult. A similar situation may exist with an irritation of the ureter from a ureteral calculus, affecting motility of the ureters, or from the viscerovisceral reflex facilitation from gastritis or a peptic ulcer, affecting the pyloric sphincter, delaying the emptying of the stomach.

Sympathetic outflow will reduce the secretions throughout the GI tract. Of clinical significance is the reflex viscerovisceral facilitation that occurs in patients with either gastritis or a gastric ulcer. This results in reduction of secretions of stomach glands that would normally contribute to a protective bicarbonate barrier to stomach acid and therefore promotes an environment for increased mucosal damage. Finally, in experimental trials, pancreatitis has been found to become much more severe in the face of increased sympathetic outflow (25). Pancreatitis commonly produces a significant, bilateral reflex that results in increased sympathetic output to the pancreas.

The discussion of reflex facilitation would not be complete without a mention of the pelvic innervation. It is of note that there is no mention of sacral or pelvic findings in the literature in response to diseases of the lower GI or pelvic viscera (8). Similar to the discussion of vagal reflexes at C2, if reflex facilitation occurred via the pelvic nerves, it would not present with sweat gland or cutaneous vascular changes. In the pelvis, there is also the absence of deep, intersegmental musculature and, therefore, somatic muscular findings, the other most common finding associated with acute segmental facilitation, is not evident. If reflex facilitation did occur in the pelvis, it might present with a completely different set of palpatory findings than those occurring elsewhere in the body. Animal studies have demonstrated increases in GI motility with stimulation of the skin of the lower abdomen and pelvis. The sacrum should be included in the evaluation and treatment plan of any viscera that have a pelvic innervation. The sacrum will be presented in this chapter when considering treatment of segmental facilitation.

Often, the consequences of facilitation create physiologic imbalance that interferes with the body's response to a challenge. Segmental facilitation is a consequence of many acute diseases, especially those producing pain and/or inflammation. One osteopathic treatment goal is to remove somatic dysfunctions of related segments to reduce their somatic contribution to the facilitated spinal cord segments. Another goal might be to improve the general function of the nervous system.

Neuroendocrine Immune Considerations

The hypothalamus, and the neuroendocrine immune system that it controls, is at the center of the body's response to the almost unlimited variety of challenges from the body's external and internal environments. It is central to the maintenance of homeostasis in the face of these challenges, and deeply involved in the body's response to virtually all acute illnesses. The hypothalamus exerts immense influence on the central functioning of the autonomic nervous system, the pituitary gland, and through it, by way of the autonomic nervous system and adrenal glands, the entire endocrine system and the immune system. The physiology of the hypothalamic-pituitary axis is also vulnerable to the neurophysiologic effects brought about by the mechanical dysfunctions resulting from somatic dysfunction.

Information about the local functioning within the body is monitored by the hypothalamus in several ways. The ability of the hypothalamus to respond to internal and external changes will depend on the accuracy of its inputs. The hypothalamus receives a large input from the nociceptive system, via the spinohypothalamic tract (29). Spinal cord facilitation will exaggerate this source of input, affecting the degree and quality of the response. The hypothalamus also receives input about levels of inflammation and immune activity in the body from circulating leukotrienes, delivered to the systemic circulation by the lymphatics (18). Levels of circulating leukotrienes are monitored by circumventricular organs in the third and fourth ventricles (30). This system will operate at maximum effectiveness when circulation and fluctuation of cerebrospinal fluid is undisturbed. Reduced rate and amplitude of the primary respiratory mechanism will reduce the fluctuation of the cerebrospinal fluid.

The pituitary gland sits within the sella turcica of the sphenoid. The hypothalamus is just above, in close relation to the body of the sphenoid and sphenobasilar junction. The pituitary gland has a portal circulation, similar to the portal circulation of the liver. The liver is situated against the undersurface of the diaphragm and is anchored to it, and the respiratory movement of the diaphragm provides the motive power for its circulation. The pituitary gland has a similar anatomic relation to the diaphragma sella. The diaphragma sella continues into the sella turcica. It completely surrounds the pituitary gland and blends with its capsule (31). The diaphragma sella is a continuation of the anterior reaches of the tentorium cerebelli. The movement of the sphenoid and the tentorium cerebelli would, therefore, alternately change the shape of the gland with the phases of the primary respiratory mechanism, pumping the fluid within it. It has been suggested that the portal circulation of the pituitary is bi-directional; the backward movement from the pituitary gland to the hypothalamus is theorized to be important to the feedback regulation of the hypothalamic pituitary axis (31). This is also a possible mechanism for the central distribution of corticotropin-releasing factor (CRF), which has far reaching effects in the central nervous system. The alternating movement of the primary respiratory mechanism would explain the ability of this circulation to move in alternating directions. W.G. Sutherland described the importance of the motion of the sphenoid to the functioning of the pituitary gland (32) It is important to consider treatment of somatic dysfunctions of the cranium, including the sphenobasilar area, in the management of the acutely ill hospitalized patient.

Approach to Thorax

Sutherland writes, "The diaphragm is the 'piston' to the big 'combustion cylinder' of the body. Its crura are the 'legs' that lead down from the piston to the 'crankshaft' in the lumbar vertebrae. Its ligamenta arcuarta are the 'piston rings.' The lungs might represent the 'combustion chamber' to the cylinder while the nasal region the 'carburetor,' while the 'ignition' and 'self starter' might be found somewhere in the 'cranial bowl'." (32)

The thorax contains the heart, lungs, and mediastinum and its contents. These structures are related anatomically by their fascial attachments. The fibrous pericardium blends inferiorly into the central tendon of the diaphragm, this relation is important to diaphragmatic function. The fibrous pericardium attaches to the sternum via the sternopericardial ligaments, and is continuous superiorly with the mediastinal fascia, which blends with the anterior cervical fascia at the inner aspect of the clavicles and manubrium. The anterior cervical fascia, including the pretracheal fascia, has attachment to the hyoid bone and mandible before finally hanging from the cranial base. This continuity must be considered in any approach to manipulative treatment of the thorax, neck, or cranium.

Breathing is largely a mechanical process by which intrathoracic pressure changes are created via the action of skeletal musculature on the spine and bony thorax. It also produces pressure gradients between the thoracic and abdominal cavities. This process is critical to the movement of both air and fluids throughout the body. A detailed look at the mechanics involved will offer insight as to how osteopathic treatment may improve the efficiency and effectiveness of breathing in the acutely ill patient, an important consideration whether or not the patient is suffering directly from a respiratory problem.

The physical action of producing a negative intrathoracic pressure requires a definable amount of energy, referred to as the work of breathing. Although difficult to quantify, increased work of breathing is clinically relevant, since many pulmonary problems dramatically alter the work of breathing. Restrictive lung diseases, by their very nature, increase the work of breathing. West considers increases in work of breathing an important factor in the pathophysiology of COPD (33). In the pathophysiology of asthma, patients progress to respiratory stage three and ultimately to respiratory failure due to an inability to maintain a state of hyperventilation caused by fatigue and the eventual exhaustion of the respiratory musculature. This failure is directly related to increased work of breathing in the patient with acute asthma. The work of breathing is a quantitative measure of the energy required by the body to overcome the resistance of the lung parenchyma and chest wall and accomplish inhalation and exhalation. Compliance is the ease with which those tissues are stretched (moved). Lung compliance is clearly reduced in all of the above diseases, contributing to the overall increased work of breathing. Restrictive diseases directly alter lung elasticity. Obstructive diseases reduce compliance through increased airway resistance and a variety of other factors.

Somatic dysfunction, by its definition, will reduce the compliance of the bony thorax in patients with pulmonary diseases and increase the work of breathing. Somatic dysfunction of the thoracic spine and ribs has been noted by a number of sources (5). The general shape changes of the thorax in COPD (barrel chest) can produce dramatic changes in chest wall compliance which are obvious on osteopathic structural examination and, in addition to the specific dysfunctions noted in association with pulmonary disease, actually stand out. General techniques will be described to address general compliance issues, as well as more specific techniques for individual somatic dysfunctions. Osteopathic treatment to improve the compliance of the thorax will not necessarily directly alter the parenchymal pathology, especially those with chronic lung disease. However it will improve issues such as exercise tolerance, giving the patient the ability to function with their disease. West notes the effect of the work of breathing on exercise tolerance of the chronic lung patient (34).

In addition to general changes in compliance of the bony thorax, specific somatic dysfunctions may have an effect on the function of the respiratory mechanism that goes beyond the small changes in compliance they invariably produce. The movement of a typical rib during breathing operates in conjunction with the orientation of its costotransverse and costovertebral joints (Fig. 71.7). Rotation of the thoracic vertebrae with somatic dysfunction will not only create resistance to movement, but will change the orientation of the costotransverse and costovertebral articulations, produce thoracic fascial torsions, and further impair the ability of the muscles to move the rib during inhalation. With rotation of thoracic vertebral units involved in somatic dysfunction, a rib with a predominantly bucket handle movement might become oriented to move more in a pump handle movement.

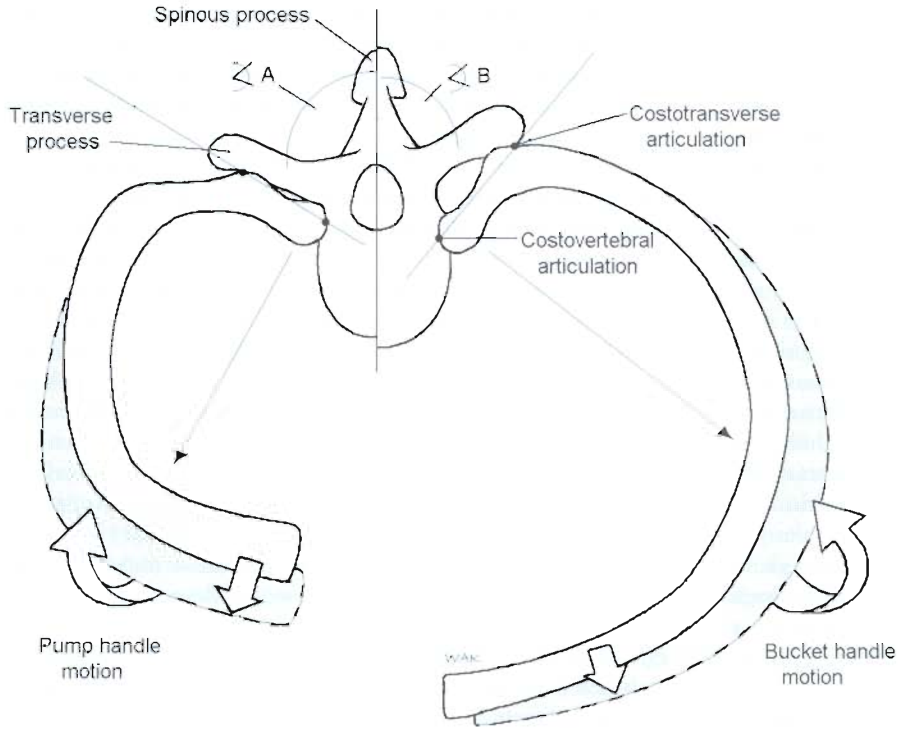

FIGURE 71.7. The orientation of the costotransverse and costovertebral articulations helps determine the direction of movement of a rib with respiration.

(Fig. 71.8). Lumbar somatic dysfunction, particularly in the upper lumbar spine, will alter the length and orientation of the crura and may, thereby, impair their function in connection with the contraction of the diaphragm.

Cathie describes movement of the entire spine with respiration (9). During inhalation all spinal curves straighten, including rotation of the sacrum with the base moving posteriorly. The reverse movement occurs with exhalation. Somatic dysfunction anywhere in the body may adversely affect breathing.

Increases in work of breathing contribute to respiratory muscle fatigue. Respiratory muscle fatigue has been generally implicated in the pathophysiology of respiratory failure. In particular, obstructive diseases produce respiratory muscle fatigue because of the effects of hyperinflation (35). Muscular fatigue has been long understood as the immediate factor leading to the demise of the patient with acute asthma. Their muscles of inspiration exhaust and the patient can no longer hyperventilate to maintain adequate air exchange. Respiratory muscle fatigue is also important in COPD, and has led to the identification of chronic respiratory muscle fatigue in the pathophysiology of lung disease (36). Respiratory muscle fatigue has also been implicated in diverse problems such as pulmonary edema, lung shock, and difficulties weaning patients off ventilators (36,37). Increasing the compliance of the thorax will reduce the load on the respiratory muscles and may reduce the likelihood of fatigue in both acute and chronic conditions. Osteopathic treatment may also be used to improve the function and efficiency of the respiratory musculature.

Respiratory muscles, like all skeletal musculature, operate on the principle of their length-tension relationship. In this relationship, muscles will develop a far stronger contraction at a longer resting tone. Consider the typical physical changes associated with exacerbations of obstructive lung disease, such as a flattened diaphragm visualized on radiograph or the hypertonicity of accessory muscles, such as sternocleidomastoid. These are indications of shortened musculature that will have a reduced contractile force in the face of an increased workload. In the case of chronic obstructive lung disease, the barrel type changes in the thorax will actually prevent inspiratory muscles from returning to full resting length during exhalation. Likewise, increased tone in the inspiratory musculature may prevent the thorax from fully assuming the position of exhalation, contributing to the overall shape change of the thorax. In addition to altering the length-tension curve, increasing the resting tone of the respiratory musculature will alter its blood supply and oxygen supply/demand ratio.

Muscles get most of their blood supply during their resting or diastolic phase. The increased tone during contraction increases the pressure within the muscle, and shunts blood away via nonnutritive arterioles. This has been demonstrated in the diaphragm (36). It has also been shown that increased demand in an otherwise normal diaphragm will produce oxygen demand that is in excess of its supply (36). Increasing the resting tone of a muscle will increase its pressure and reduce the incoming blood supply, while simultaneously increasing its oxygen demand, further stressing the oxygen supply/demand ratio. Muscles forced to function anaerobically are as much as 15 times less efficient than those utilizing aerobic metabolism (38). Fatigued diaphragms have been found to have high levels of lactic acid, indicating anaerobic metabolism (36). Increased resting tone of the inspiratory musculature should be identified during the osteopathic structural examination.

Osteopathic treatment directed toward increasing the length and decreasing the resting tone of inspiratory musculature is indicated in the treatment of acute and chronic lung disease. The diaphragm in particular is prone to increases in tone and

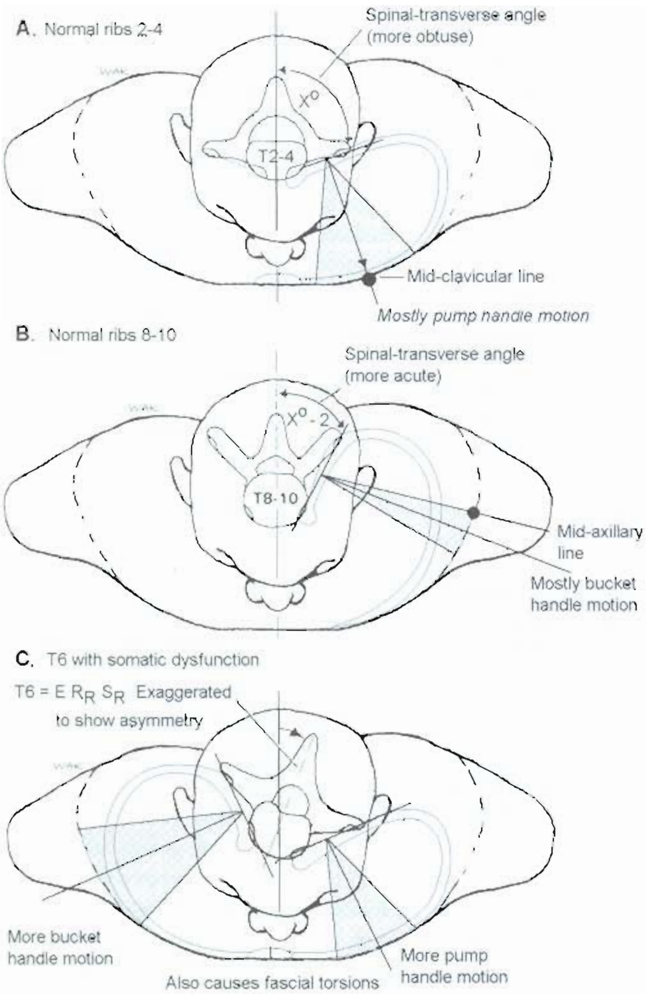

FIGURE 71.8. Vertebral rotation will change the orientation of the rib and the movement of that rib produced with respiration.

associated flattening in acute and chronic obstructive disease. The flattening of the diaphragm may become severe enough to reverse the movement of the lower ribs during inspiration, called paradoxic rib motion. This will reduce the transverse diameter of the chest, and greatly reduce the efficiency of the entire respiratory mechanism. In osteopathic literature, restoration of the length and vertical orientation of the diaphragm is called doming of the diaphragm. Doming of a flattened diaphragmatic muscle will increase the pressure gradients that it is able to produce between the thoracic and abdominal regions and can help reverse paradoxic rib motion and improve the function of the diaphragm as well as the respiratory mechanism as a whole (Fig. 71.9). Addressing the mechanics of breathing, including the work of breathing, the compliance of the thorax and spine, both specifically and generally, and the function and efficiency of the respiratory musculature will have far-reaching applications in the treatment of acute and chronic respiratory diseases.

The physiologic impact of respiration is not limited to the exchange of air. The negative pressures produced by thoracic excursion are important to the function of the circulatory system as well.

The role of respiratory movements on inferior vena caval and portal circulations has been extensively studied. Breathing has a tremendous influence on both the inferior vena cava and portal return (12). During inspiration, the negative intrathoracic pressure produced dramatically increases the flow in the inferior vena cava while, simultaneously, the compression of the liver by the descent of the diaphragm virtually eliminates hepatic flow. During this time, there is blood flow into the liver, so its pressure increases. During exhalation, the vena cava loses its pressure gradient and flow decreases substantially. This is balanced by the large portal flow from the pressurized portal veins of the liver, as the diaphragm lifts off. Return to the heart remains somewhat balanced. However, the composition of the blood differs greatly between these two phases of the respiratory cycle. The effect of respiration on central venous flow is greatest in supine, nonactive patients, who lose the effects of the peripheral pumps created by muscle contraction. Zink noted this when he presented his model of respiratory/circulatory function (10). This encompasses the vast majority of acutely ill hospital patients, who are bedridden most, if not all, of the time during their convalescence. Patients with congestive heart failure demonstrate a clinical application of this concept. These patients develop fluid congestion in their liver and lower extremities. They consistently have substantial restriction of their diaphragmatic excursion, as can be determined by structural examination. Treatment of the diaphragm improves the overall circulatory function and venous back pressure is reduced, decreasing afterload on the heart (Fig 71.10).

The action of the diaphragm and thorax also has a major influence on the function of the lymphatic system. This is the second aspect to the "respiratory/circulatory" model. Zink's original model described the role of respiration, with its action on central venous flow and pressure, as they influence the emptying of the thoracic duct into the junction of the internal jugular and brachiocephalic veins. This idea has since been confirmed with studies measuring thoracic duct flow in relation to respiratory excursion. A variety of studies have measured the role of respiration in the movement of thoracic duct lymph, estimates from these studies show 35% to 60% of the total thoracic duct drainage is in response to movements occurring during respiration (39–41). The excursion of the thorax has also been shown to be involved in the formation of lymph in a variety of areas, including the lungs and abdomen. Lymph formation is a critical step in the overall mechanics of the lymphatic circulation. A small but significant uphill hydrostatic gradient exists that must be overcome in order for fluid to move from the interstitium into the initial, blind lymphatic vessel (39). The excursion of the thorax has been shown to be the primary force moving fluid from the pulmonary interstitium to the initial pulmonary lymphatics. The expansion of the pulmonary interstitial tissue, to which the initial lymphatics are tethered by anchoring filaments, increases the volume of the initial lymphatic vessel and produces a temporary pressure gradient for filling the initial lymph vessels. Exhalation then closes the vessel and moves the lymph forward, past the first valve and into the contractile part of the vessel. The respiratory cycle then produces a pump that initiates the process of lymph formation. All initial lymphatics have anchoring filaments, and will therefore respond to respiratory movements to the degree that they occur

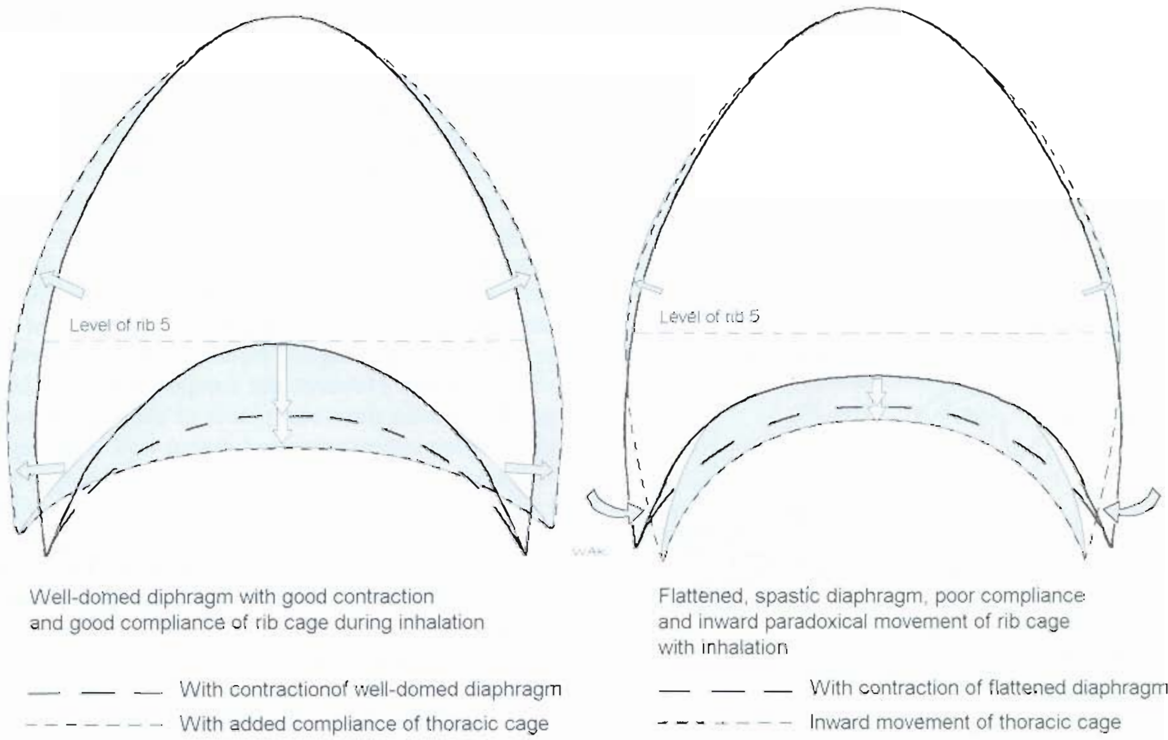

FIGURE 71.9. The mechanical effects of contraction of the diaphragm. **A:** Normal excursion of a compliant thoracic rib cage with contraction of a well-domed diaphragm. **B:** Reduced excursion of thoracic cage and even the possibility of paradoxic motion of the lower rib cage with contraction of a flattened abdominal diaphragm.

in the area. The initial lymphatics in the abdomen and pelvis, in particular, respond significantly to respiratory excursions.

The clinical significance of this mechanism is considerable. Lobar pneumonia is an example of an intrapulmonary inflammatory process that will greatly increase the demand on the local lymphatic circulation. The local excursion of the thorax, however, is consistently and significantly reduced in the local region of the consolidation. This discrepancy will reduce the drainage of the exudate produced by the local inflammation, reduce the delivery of antigen to lymph nodes, and ultimately reduce the delivery of immunity and antibiotics to the area as interstitial pressure rises and shunts blood away from the area. Restoring local excursion of the thorax will improve the body's ability to move lymph in this situation; specific lymph pump techniques are also indicated. Asthma is an example of a more generalized inflammatory process of the pulmonary tissues. This disease produces

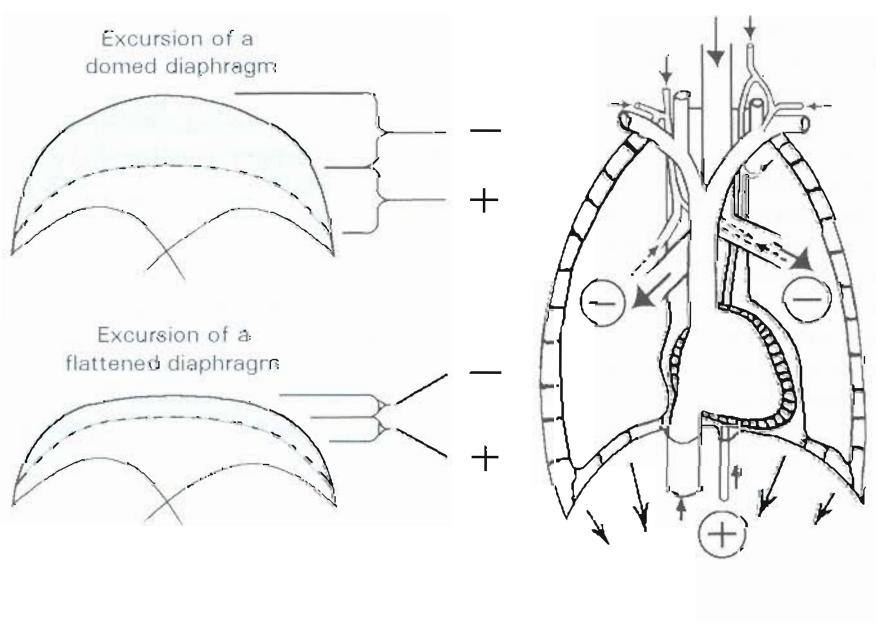

FIGURE 71.10. The excursion of the diaphragm has a powerful influence on venous and lymphatic return. This effect is reduced when the resting diaphragm is flattened.

a significant, overall restriction of the thorax to the exhalation phase of respiration, reducing both local drainage of lymph from the small airways and central lymph drainage through the thoracic duct. This physiologic model should also be considered in patients who have had a thoracotomy and/or sternotomy. These procedures produce intrathoracic inflammation that simultaneously and dramatically reduces the patient's ability to produce excursion of the thorax in the postoperative period.

The work of breathing, with its mechanical considerations associated with respiration, and its respiratory/circulatory function, with its role in the body's response and recovery from disease (especially inflammatory processes), must be considered in the osteopathic evaluation and treatment of any disease of the thorax. The work of breathing directs one to consider the compliance of the thorax, most easily evaluated by motion testing of the spine and ribs. Respiratory/circulatory function depends on the excursion of the thorax, evaluated by passively observing the patient's respiratory excursion. Although there is an undeniable relationship between compliance and excursion, separate evaluation and consideration of these will lead to a more accurate understanding of the patient and a more appropriate and effective treatment plan. For example, a relatively strong and healthy COPD patient may have a relatively good excursion, but a much reduced thoracic compliance, best seen by motion testing of the ribs and thorax. Alternately, a patient just out of surgery will have a greatly reduced excursion, but the compliance may be relatively good. These two situations will lead to very different treatment programs. The ability to address compliance and excursion of the thorax is an important reason for including osteopathic manipulative treatment in the management program of patients with a wide variety of diseases.

Approach to Abdomen/Pelvis

The abdomen and pelvis form a single space, even though anatomists separate this space into two divisions. The abdomen, viewed as a single space, functionally contains, supports, and influences the function of the GI and the genitourinary viscera (see Chapter 51, Abdominal Region, Fig. 51.1). The lower ribs and their thoracic vertebral attachments, lumbar spine, sacrum, and pelvic bones form the osseous components of this container. The diaphragm, anterior and posterior abdominal walls, and pelvic diaphragm are the myofascial components. The abdominal diaphragm is as integrated to the function of the abdomen as it is the thorax. The diaphragm forms the roof of the abdomen, and suspends the liver, stomach and spleen, and colon via direct ligamentous attachments (Fig. 71.11). Flattening of the diaphragm, which may result from increases in its resting tone, airway obstruction, or sag from fascial strain and drag, will allow sag of these viscera as well as those suspended beneath them. The posterior attachments of the diaphragm, which lie within the abdomen, are mechanically important. They provide the stable fulcrum necessary for effective contraction. The crura blend with the anterior longitudinal ligament of the upper lumbar spine, usually L1-3. Posterolaterally, the lumbocostal arches extend across the posterior abdominal wall to the tips of the 12th ribs on either side. The medial lumbocostal arch is a thickening of the psoas major fascia (Fig. 71.12). Its medial aspect blends with the crus of the

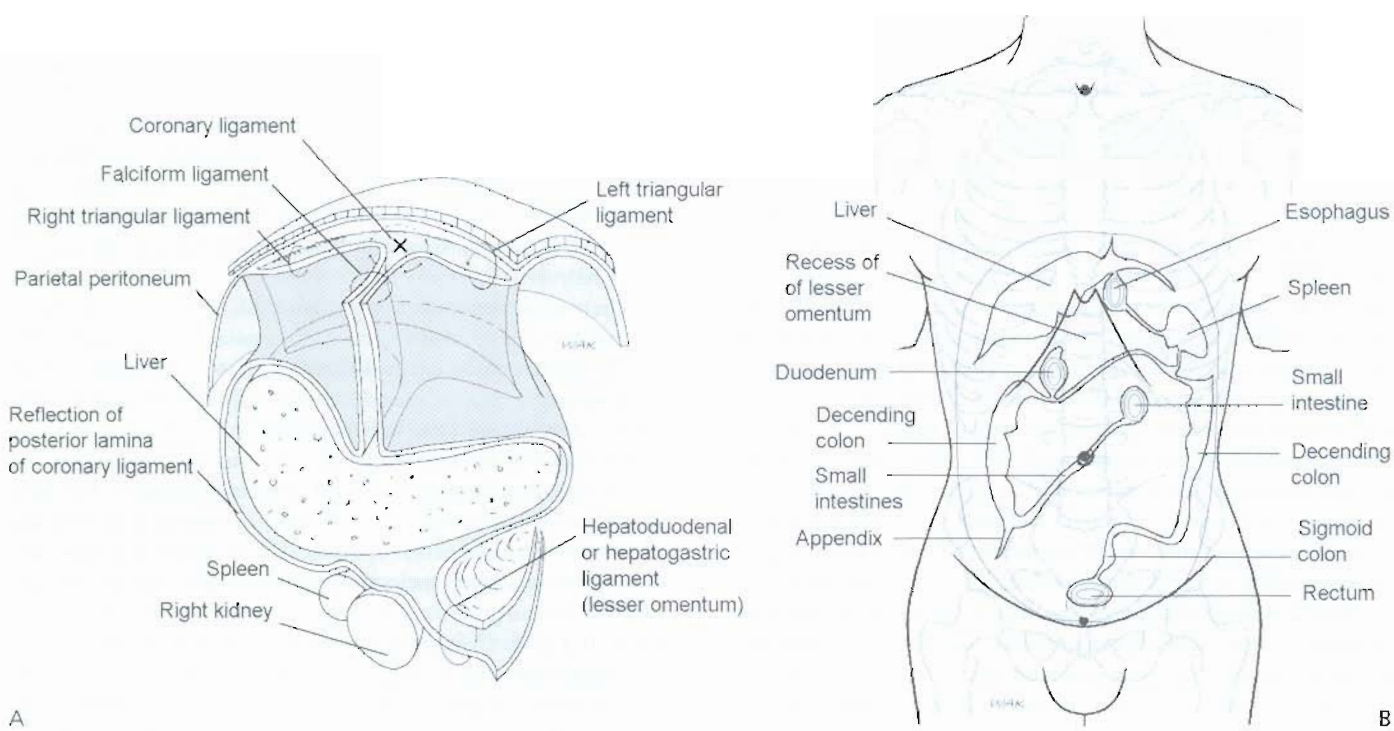

FIGURE 71.11. **A:** The attachments of the liver to the diaphragm. These are firm and allow the diaphragm to strongly influence portal circulation. **B:** The attachments of the abdominal mesenteries. These provide support for the abdominal viscera as well as providing the pathways for their neurovascular supply.

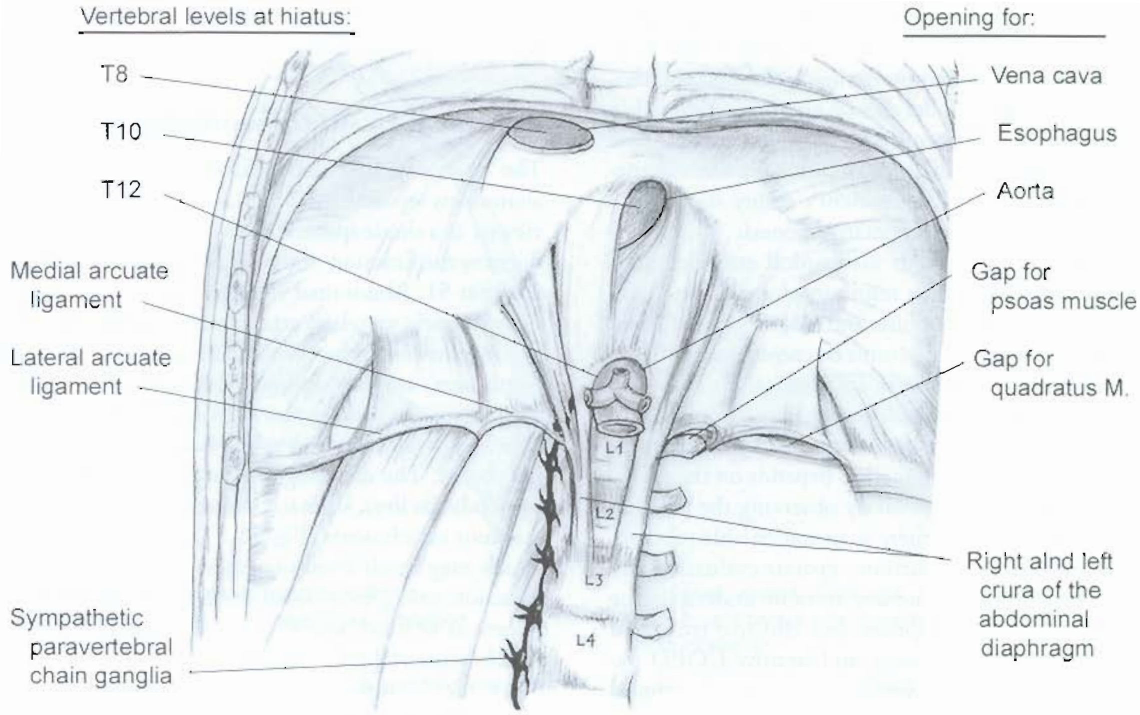

FIGURE 71.12. The abdominal surface of the diaphragm. The crura and lumbocostal arches blend, forming a continuous series of arches which anchors the diaphragm posteriorly to the 12th ribs and lumbar spine.

diaphragm. It then crosses over the psoas muscle and is laterally attached to the front of the transverse process of the first lumbar vertebra near its tip. Here it blends with the lateral lumbocostal arch. The lateral lumbocostal arch is a thickening of the quadratus lumborum fascia. Medially it is attached to anterior surface of the tip the transverse process of the first lumbar vertebra. It then crosses over the quadratus lumborum muscle and is attached laterally to the lower border of the 12th rib. Together, the lumbocostal arches and the right and left crus of the diaphragm, attaching to the lumbar spine, form a continuous series of five arches which integrates the function of the diaphragm and posterior abdominal wall. Mechanical support for the contraction of the diaphragm comes from the crural anchors to the lumbar spine and from the depression and stabilization of the 12th rib through the contraction of the quadratus and tension in the lumbocostal arches. The continuity of the posterior abdominal wall to the pelvic brim and to the lesser trochanter of the hip allows these more remote, but important, mechanical anchors to also be included as supports for diaphragmatic contraction. Evaluation and treatment of somatic dysfunctions of the crura and lumbocostal arches via the 12th ribs and lumbar spine will have a major impact on the excursion and physiologic function of the diaphragm.

The diaphragm has openings for the passage of numerous structures between the thorax and abdomen (Fig. 71.12; and also Chapters 50 and 51). The esophagus passes through a loop in the right crus that acts as the most substantial functional portion of the gastroesophageal sphincter. Dysfunction of the crus is often present in patients with gastroesophageal reflux and hiatal hernia. Osteopathic manipulative treatment directed toward altering tension of the crus may be helpful in the management of patients with these problems. The aorta and the cisterna chyle, or beginning of the thoracic duct, pass between the right and left crus. The potential effect of the phasic contraction of the crura on the normal central lymph flow, through the thoracic duct as part of an overall effect of respiration, must be considered. Conversely, the potential for obstruction of central lymph flow with increased tension in the crura must be considered as well. The sympathetic chain with its paraspinal ganglia pass through the medial lumbocostal arch. Several authors have implicated that altered tension of the fascia surrounding the chain ganglia has an effect on the function of the sympathetic chain ganglia (4,25,32).

The passage beneath the lumbocostal arch is a small, tight space vulnerable to altered tension of the psoas and/or diaphragm. The inferior vena cava passes through the tendinous portion of the diaphragm near its apex. Unequal tension in the diaphragm, either side to side or front to back can draw the central tendon off center and alter the size, shape, and position of this opening, interfering with passage of blood through the diaphragm. As stated by Dr. Still, "He cannot expect blood to quietly pass through the diaphragm if impeded by muscular constriction around the aorta, vena cava, or thoracic duct. The diaphragm can and is often pulled down on both the vena cava and thoracic duct, obstructing blood and chyle (lymph) from returning to [the] heart" (42). In this regard, one must consider the potential deleterious effects of altered tension in the diaphragm on venous and lymphatic circulation as an additional consideration, using treatment according to the respiratory circulatory model. The diaphragm, on a variety of levels, is intimately involved in the function of the GI system, the circulatory system, and the nervous system.

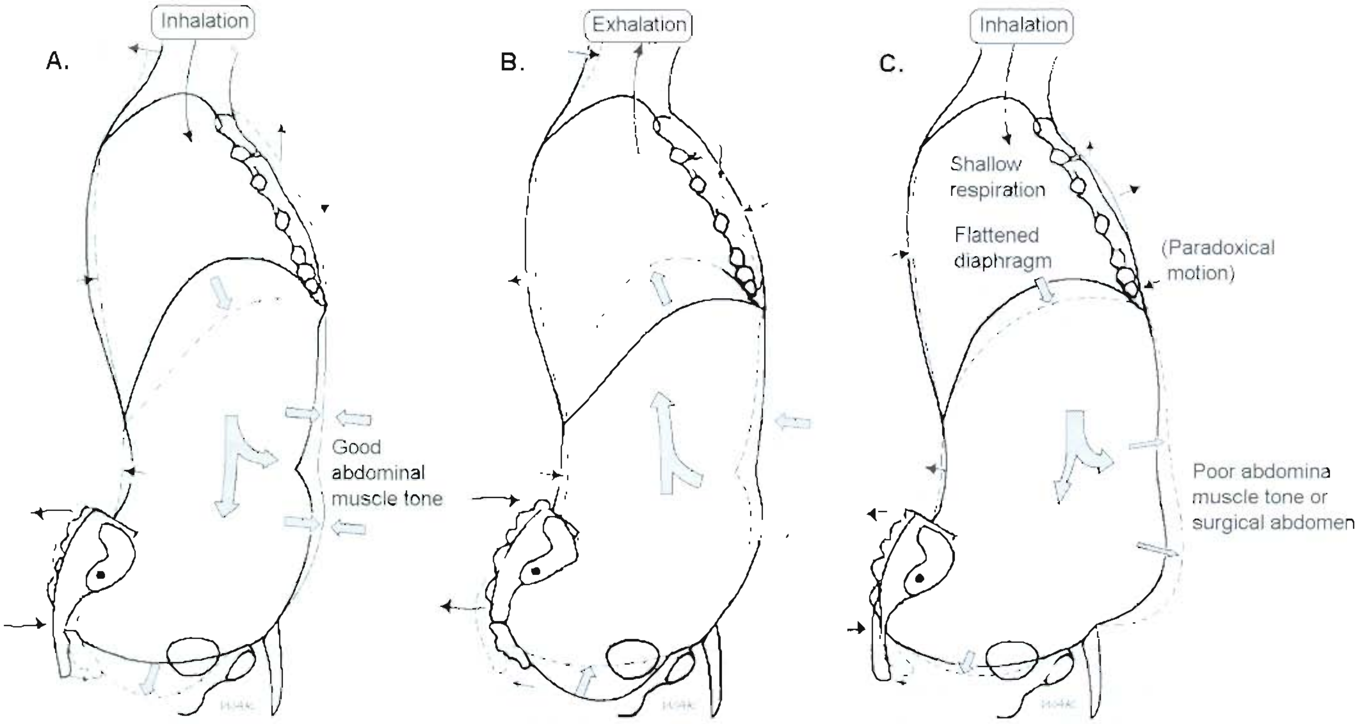

FIGURE 71.13. **A & B:** Relative movements and function of the abdominal diaphragm, pelvic diaphragm, abdominal wall, spine and sacrum occurring during respiration. **C:** The effect of a significant abdominal surgical incision or presence of poor abdominal tone on the physiologic movements occurring during breathing.

The iliacus, psoas, and quadratus lumborum constitute the posterior abdominal wall. The role of the posterior abdominal wall in the mechanical function of the diaphragm has been discussed, particularly the lumbocostal arches. The posterior abdominal wall is also involved in support of the abdominal viscera. The psoas fascia blends with the fascia of the kidney and is the primary support for this organ. The iliopsoas forms a shelf as it crosses the pelvic brim and this helps to support the cecum and sigmoid colon. Increased tension in this region will reduce the overall support of the colon, and may predispose to sag of the viscera and the mesenteries. The posterior abdominal wall is also the site for most of the posterior mesenteric root attachments (see abdominal mesenteries shown in Fig. 71.11), and this further increases its importance as support of the abdominal viscera. The ureter travels along the medial aspect of the psoas in the abdomen. It is not surprising that psoas spasm is a common finding in nephrolithiasis and pyelonephritis. The deep abdominal lymph nodes also travel in relation to the iliopsoas as they ascend from the inguinal area to the diaphragm. The tendon of iliopsoas also forms the floor of the femoral triangle where the inguinal lymph vessels and the femoral veins cross into the pelvis and abdomen.

The pelvic diaphragm forms the floor of the abdominopelvic cavity. Its muscular attachments include the pubic symphysis, the ischial tuberosities, and the coccyx and sacral apex. In addition to supporting the pelvic viscera, including the prostate in the male, the pelvic diaphragm forms the external anal sphincter and has an opening for the passage of the urethra and, in the female, the vagina. Sensory nerves in the pelvic diaphragm are part of the reflex control mechanism for urination. In addition to its roles in the function of the bladder and rectum, the pelvic diaphragm has a role in respiration. The pelvic diaphragm descends with the abdominal diaphragm during inhalation, creating space for the descending abdominal viscera (Fig 73.13). Clinically, there is tension palpable with its descent. The pelvic diaphragm may act in conjunction with the anterior abdominal wall, lengthening under tension to control the descent of the diaphragm and stabilize abdominal pressure. The abdominal diaphragm will lose the important fulcrum created by the resistance of the viscera if abdominal pressure is reduced by poor tone of the abdominal wall or dysfunction of the pelvic diaphragm. If abdominal pressure is allowed to rise, the increased resistance reduces the effectiveness of the diaphragm and reduces inferior vena caval flow. One of the problems occurring after abdominal surgery is the reduced ability of the abdominal wall to participate in this process. The role of the pelvic diaphragm becomes heightened in the postsurgical patient, and freedom of the sacrum and pelvic diaphragm are essential in this situation.

The integrated function of the diaphragm, pelvic diaphragm, and abdomen, occurring as the patient breathes, plays a significant role in the prognosis of the postsurgical patient. The most common complication from abdominal surgery is atelectasis and pneumonia. The patient is predisposed to these complications by the shallow, costal breathing that is so common in postoperative cases. Although usually considered to be one of the effects from pain, it has been shown that intraoperative epidural injection, completely blocking postoperative pain does nothing to alter the limited and dysfunctional diaphragmatic breathing pattern

(43). Other explanations for the pattern of altered postsurgery diaphragmatic breathing include the effects of the somatovisceral reflex produced by the incision and the altered abdominal wall function. A midline abdominal incision extending from the xiphoid to the pubes will produce bilateral reflex facilitation from the T5-7 region (including ribs) all the way to the L2-3 area. This includes the entire attachment of the diaphragm, including the crura, and disproportionately increases the lower thorax workload and limits its excursion. The coordinated action of the abdominal wall and diaphragm is impaired. The abdominal incision alters the tone and reactivity of the abdominal wall, impairing its ability to help control inhalation. Osteopathic treatment of the lower thorax and lumbar spine will improve compliance of these tissues, thereby reducing the resistance against which the diaphragm must push. It will simultaneously reduce sympathetic outflow to the entire GI tract and thereby reduce the chance of postoperative ileus, another common postoperative complication. Treatment of the sacrum and pelvis with a focus on maximizing the excursion of the pelvic diaphragm will help compensate for the reduced ability of the abdominal wall to participate in the coordinated control of inhalation.

Respiration also plays a role in the abdominal lymph circulation. The role of breathing in the central movement of lymph has already been discussed. Respiration also exerts a powerful influence on the formation of lymph in the abdomen (44); only peristalsis is more influential (45). The postsurgical abdomen, particularly when peritonitis is present, responds with a tremendous inflammatory process. At the same time, the two most powerful factors in the abdomen related to the accumulation of lymph and the reduction of lymphatic flow are impaired breathing and the absence of peristalsis. Osteopathic treatment to promote lymph formation and flow is important to the immediate healing process. The inability to clear inflammatory exudate increases the potential to produce the most common long-term complication of abdominal surgery, adhesions. Most diseases of the abdomen are inflammatory, and will respond to osteopathic treatment to promote the formation and propulsion of lymph. Lymph flow may be obstructed at the crura of the diaphragm, and this region must be evaluated and treated if indicated. Lymph vessels exit the peritoneal cavity via the mesenteric roots, and drag on these mesenteries will increase the tension at the root, which may also obstruct the flow of lymph. Mesenteric drag is a common finding in postsurgical and medical problems of the abdomen and pelvis, and may be treated carefully with mesenteric lifts, to promote the flow of lymph.

TREATMENT APPROACHES

General Considerations

First the patient is evaluated and the structural findings are interpreted in relation to the above principles and an understanding of the patient's disease process. Then a treatment plan is developed to address the dysfunctions in such a way as to improve the function of the patient's underlying physiology. Often, a single area will need treatment based on several different models. In most, if not all cases, there will be multiple physiologic issues that can be addressed simultaneously through a treatment process. For example, an area of the thoracic spine and ribs may be facilitated in a patient who has a dysfunctional breathing pattern and central lymph congestion. In such a case, the ribs need only be treated once to accomplish all three treatment goals, as the choice of technique is one that is consistent with accomplishing all three goals. Furthermore, the techniques described in each of the treatment areas that follow, may or may not be the proper choice for any particular patient, even if they have the same diagnosis. The choice of technique is based on the effect desired and the condition of the patient. Sometimes it is the combination of techniques in a particular sequence that best achieves the desired physiologic effects.

It is important to keep the treatment within the capabilities of the patient. It is often difficult, if not impossible to know what those capabilities are before initiating the treatment. It is also difficult to know in advance which techniques will be effective and well tolerated. Therefore, in the acutely ill patient, it is often best to apply a focused manipulative treatment, in a minimal effective time frame and then recheck later to see how the patient responds. At that time the type and dosage of treatment for that patient can be better formulated. A most effective way to consistently provide a safe and effective treatment is to monitor the effect of a chosen technique on the patient while it is being performed, sensing how the tissues are reacting to the technique, and modifying the technique, as indicated, as it is being applied. A common mistake of the inexperienced practitioner is to place all of their attention on the procedural aspects they are performing, and not sense the dynamic nature of the patient's tissue changes, occurring during the treatment process. By placing attention on the patient and their tissues as the treatment is performed, several things become possible. The technique and the forces involved may be continuously adjusted to the response of the tissue, making the treatment more effective. This is particularly useful in deciding between a direct and indirect method of treatment in a particular area. The initial impression may be to perform a direct method treatment, but, as the tissue barriers are engaged, the response of the tissue may suggest that an indirect approach should be performed instead.

If the initial impression suggests an indirect approach, but as the tissue is positioned into its point of freedom there is no palpatory sense that the tissues are responding to the treatment method, the operator may need to use a direct approach, or at least recheck the diagnosis and/or the original positioning of the patient. The choice between direct and indirect approaches is an important one; indirect approaches are, by their nature, gentler than direct approaches. Since the activating force for the treatment comes from within the patient, it is virtually impossible to give a treatment in excess of the tolerance of the tissue, or the patient as a whole. However, since they require internal forces to generate the therapeutic response, sometimes the sickest patients are unable to generate enough force to accomplish the desired effect from an indirect method and a direct method technique will be the more appropriate and effective one to use.

If the findings on structural examination do not initially suggest a physiologic treatment plan, treatment to arbitrarily reduce somatic dysfunction *should not be initiated.* It is far wiser to repeat the examination over the course of the illness, obtaining added clues as to the relation between the osteopathic findings and the pathophysiology of the disease process. It stands to reason that those somatic dysfunctions involved in the disease will change as the disease progresses, either improving or getting worse with the patient's condition. Once a better understanding of the relationship between the somatic dysfunction and disease process is achieved, a physiologic treatment plan to assist that patient's recovery from their disease will be apparent, and may be initiated.

Segmental Facilitation

A viscerosomatic reflex is produced when nociceptor input from inflamed viscera reaches a level great enough to produce facilitation of the interneurons of the spinal cord on which they converge. Spread of the impulses within the facilitated cord segment to involve the somatic neurons and the resulting muscle spasm produces a palpable, segmental somatic dysfunction, which, in turn, stimulates somatic nociceptors. This somatic nociceptive input converges on the same spinal cord segment and involves the interneurons of the original visceral input, creating a positive feedback loop which further increases the reflex output to segmentally related viscera and soma. The goal of osteopathic treatment is to remove the added somatic input, reduce the overall firing of the segmental interneurons, and remove the potentially devastating, self-perpetuating effects of a positive feedback loop. There is no definitive technique for reducing segmental facilitation; any procedure that normalizes the somatic tissues and reduces the nociceptive input will work. Treatment is based on the condition and responsiveness of the patient. However, several guidelines should be followed when designing a treatment program to reduce segmental facilitation. The remainder of this chapter presents these guidelines and presents manipulative treatment techniques that have been found useful in treating patients with acute segmental facilitation.

Nociception

Viscerosomatic and somatovisceral reflexes are initiated through pain-carrying fibers. Rapid movements at the vertebral unit, and of course painful maneuvers, have been shown to create a sympathetic motor outburst from the related and also distant facilitated spinal cord segments. Pain experienced at the segment will create further facilitation. Vigorous or painful procedures should be avoided when treating to reduce segmental facilitation, especially in acute situations.

Order of Treatment

Neurons in facilitated segments have a low threshold and often fire off, even to signals passing through the spinal cord from other regions. Treatment of the facilitated areas first will help prevent these segments from excessively firing impulses to their related viscera in response to treatment given in another region. Extremely reactive segments may actually require several treatments before other body areas can be effectively treated, although this is unusual. Gentle, deliberate procedures used throughout the entire treatment will minimize this effect.

Frequency of Treatment

Facilitated segments are often the result of acute visceral processes. The underlying disease will reproduce facilitation at the segments, often quite rapidly. Frequent treatment, even more than once daily, is indicated. As the process improves, treatment frequency may be decreased.

Articular Tissues

Although the most obvious signs of acute segmental facilitation are found in the soft tissues, remember that treatment is directed to those tissues sending somatic nociceptive information back into the spinal cord. Muscle has a low concentration of nociceptors, whereas a joint capsule has the second highest, next to the skin. Treatment directed toward articular tissues may have a greater effect on the segmental facilitation than soft tissue techniques, such as myofascial releases or counterstrain. The techniques presented will all be directed toward the tension in articular segments.

Skeletal/Fascial Relations

Traditional focus has been on the areas immediately surrounding the sympathetic chain ganglia as these have an increased clinical importance in the treatment of segmental facilitation. Patriquin suggests an effect of respiratory motion on the functioning of the chain ganglia (4). Kuchera and Kuchera discuss the fascial relation of the ganglia with the rib head (25). Johnston also focuses on the costovertebral junction in his discussion of the diagnosis of viscerosomatic reflexes (7). Sutherland discusses the relationship between anterior vertebral ligamentous and fascial tension and autonomic function (32). Although the known physiology of reflex phenomena focus on the nociceptor input as the cause of segmental facilitation, and both somatic and visceral motor (via the chain ganglia) as the effects, one cannot deny the improved clinical response when the application of manipulative treatment is directed more specifically to the somatic dysfunctions and paraspinal fascial and ligamentous tissues in the anatomic location of the chain ganglia related to the patient's visceral dysfunction. The sacral plexus lies anterior to the sacrum. The lumbar chain ganglia lie anterior to the bodies of the lumbar vertebrae, medial to the edge of psoas. The thoracic chain ganglia lie anterior to the heads of the ribs. The cervical ganglia lie anterior to the cervical transverse processes.

SPECIFIC MANIPULATIVE TREATMENT TECHNIQUES

All of the techniques described here are direct method; they engage a restrictive barrier and involve the application of an activating force. They are especially applicable in the hospital patient, and may be used to produce a wide variety of physiologic effects. Force should always be introduced gradually, with attention to the patient and to the patient's response, and maintained at the level that matches or balances the resistance or tension felt in the tissues.

Indirect method techniques may also be used in the treatment of acute segmental facilitation, and should be considered especially in patients whose tissues are sensitive or reactive to the application of outside forces. Indirect technique, on the other hand, will not always work, because the acutely ill patient may not be able to generate the inherent forces necessary to affect a good response to the treatment process.

Paravertebral Ganglia Techniques

Direct Rib Release

Position

1. The patient is supine. The operator is seated at the side of the patient.
2. One hand of the physician identifies a single rib to be treated. The other hand extends under the patient to the spinous process and identifies the two segments with which a typical rib articulates. This is most easily done by gently springing the rib medially while monitoring at the spinous process.
3. Contact the two vertebrae at the spinous processes and simultaneously carry the rib and two vertebrae laterally. This will disengage the costovertebral articulation.

First Rib/Stellate Ganglion Technique

The stellate ganglia sit just anterior to the heads of the first ribs.

Position

1. The patient is supine. The operator is seated or standing at the head of the bed.
2. The physician contacts the posterior aspects of the first ribs at the angle with the thumbs of each hand.
3. The physician simultaneously applies gentle lateral traction to both ribs, gradually increasing until the traction force is equal to the resistance found in the tissues.
4. Traction is held at this level until release is felt.

Suboccipital Decompression

The superior cervical ganglion and vagus nerve are related to the occipital-atlantal and suboccipital tissues.

Position

1. The patient is supine. The operator seated at the head of the bed.
2. The physician places the fingerpads in the patient's suboccipital sulcus (groove) on both sides.
3. The physician carries their elbows medially, placing lateral traction on the suboccipital tissues.
4. The physician simultaneously places gentle traction on the occiput. The force of the physician's traction matches the resistance of the tissues.
5. This position is held until release of both sides is felt.

Lumbar Ganglia Technique

Position

1. The patient is supine with their arms crossed over the chest. The operator is seated at the side of the patient.
2. The physician makes a fist with the fingers of the cephalad hand, leaving the thumb extended.
3. The physician slides that hand under the patient's upper lumbar spine, fitting the lumbar spinous processes in the depression between the distal phalanges and the base of the hand.
4. The physician applies a gentle superior lift with the cephalad hand, the knuckles and base of the hand maintaining even pressure on the respective transverse processes.
5. With the caudad hand on the patient's elbows, the physician uses downward pressure into the bed (or treatment table) to closely control the lift of the fingers, balancing the lift to the resistance felt in the tissues.
6. This positioning is held until release is felt.

Sacral Plexus Techniques

Sacroiliac Decompression

Position

1. The patient is supine. The operator is seated at the side of the patient.
2. The physician contacts the medial aspect of the posterior superior iliac spine and associated medial ilium with the fingerpads of one or both hands.
3. The physician leans back, with the arms as straight as possible to create the traction with their shoulders and trunk, rather than with the forearms.
4. The physician's traction equally matches the resistance that is palpated.
5. The physician holds until yielding or release is felt.
6. This process is repeated on the other side.

Sacral Technique

Position

1. The patient is supine with the arms crossed over the chest. The operator is seated at the side of the patient.
2. The physician contacts the sacrum in the midline, with the caudad hand on the inferior lateral angle near the sacral apex and the cephalad hand on the sacral base above the level of S2. Alternately, the physician may use only one hand and spread the fingers so that some rest above and the others rest below the S2 sacral vertebra.
3. The physician's fingers, contacting the patient's sacrum, are gently lifted anteriorly. The physician's arms are resting on the bed or table top and the degree of lift is controlled by applying downward pressure on the elbows and upward pressure with the fingers.
4. This position of lift is held until a yielding or release is felt.

Collateral (Prevertebral) Ganglia Inhibition Techniques

Abdominal Ganglia Inhibition

The celiac and the superior mesenteric and inferior mesenteric ganglia may be treated by the same method, altering the hand position on the abdomen for the different ganglia. The celiac area is below the xiphoid, the inferior mesenteric just above the umbilicus, and the superior mesenteric halfway between.*

Position

1. The patient is supine. The operator stands at the side of the patient.
2. The physician's fingerpads of one or both hands are lined up along the patient's midabdominal line, contacting the skin over the collateral ganglion that is to be inhibited.*
3. The physician applies a gentle, downward pressure until the resistance of the underlying tissues is felt and its resistance is matched.
4. This pressure is held until a softening or release is felt.

Cervical Ganglia Inhibition

Although the cervical ganglia are situated more like the collateral (paravertebral) ganglia, the cervical ganglia function more like prevertebral ganglia, having their spinal origin in the thoracic spinal cord.

Position

1. The patient is supine. The operator is seated at the head of the bed or table.
2. The physician's fingerpads contact the articular pillars of the patient's cervical spine on both sides.
3. The physician gently lifts the finger contacts in an anterior and superior direction until articular (not soft tissue) resistance is perceived and matches the degree of lift.
4. This amount of lift is held until release is sensed.

Thoracic Region Techniques

The treatments described here are designed to increase thoracic compliance and excursion. Choice of method in clinical situations will depend primarily on the condition and tolerance of the patient. One will be confronted with patients limited to the supine position, such as the postoperative thoracotomy patient, and those limited to sitting, such as the patient with COPD. Adaptability in applying treatment techniques is a key to giving an effective treatment. Appropriate caution must always be exercised when working with acutely ill patients. Autonomic and lymphatic considerations should also be applied to the thorax. They are described elsewhere in the chapter.

Seated Techniques

In acute respiratory illness, the patient is sometimes unable to lie down for treatment. Seated techniques are particularly useful in these situations. All procedures described may be done very gently or more forcefully depending on the particulars of the case. Care must always be exercised when using force in an acutely ill hospitalized patient.

*This technique should not be attempted in the postoperative patient with a midline abdominal incision.

Translation of the Spine

Since the heads of ribs two through ten articulate with a vertebral unit, rather than a single vertebral segment, the motion of the thoracic spine is intimately involved with rib motion and thoracic compliance.

Position

1. The patient is seated. The operator stands at the left side of the patient.
2. The patient's left hand is placed on the right shoulder.
3. The physician places their left hand over the patient's hand and right shoulder while allowing the left axilla to rest lightly on the patient's left shoulder for patient control.
4. The physician's right palm is placed over the patient's left paravertebral tissues near the T10-12 region.
5. The physician simultaneously leans on the patient's left shoulder and places a right lateral translatory force on the spine via the left axillary and right hand contacts.
6. The physician moves the hand contact and the apex of the translation superiorly and the right lateral translatory force to the spine is repeated until the entire hemithorax is mobilized. A focused effort may be placed on the region with the greatest restriction.
7. The physician then moves to the patient's right side, positions of the patient's arms and the physician's arms and hands are reversed and the other side of the thorax is treated with translation to the left.

Note: This mobilization by spinal translation can also be carried into the lumbar region of the body.

Rotation and Rib Raising

Position

1. The patient is seated. The operator stands at the left side of the patient.
2. The patient's left hand is placed on the right shoulder.
3. The physician places their left hand over the patient's hand and right shoulder while allowing their left axilla to rest lightly on the patient's left shoulder for control of the patient.
4. The physician's right palm is placed over the patient's lower right rib cage with the thenar eminence in the area of the tenth rib angle.
5. The physician simultaneously produces a right anterolateral translatory force as the patient's body is rotated to the left.
6. The right hand contact with the patient's right rib angles is moved superiorly and the right anterolateral translatory force and left rotation of the spine is repeated until the entire hemithorax is mobilized. A focused effort may be placed on the region with the greatest restriction.
7. The physician then moves to the patient's right side, positions of the patient's arms and the physician's arms and hands are reversed and the left side of the thorax is treated in a similar manner.

Rib Raising

Position

1. The patient is seated with arms crossed in front of the chest. The operator stands facing the patient.
2. The patient's arms are supported on the physician's chest and the physician's hands reach around the patient to contact the patient's rib angles on both sides.
3. The physician leans so that gentle extension of the patient's thoracic spine occurs and simultaneously carries the contact with the patient's ribs, anteriorly and superiorly.
4. The physician's hand contacts with the patient's rib angles superiorly and/or inferiorly and the procedure is repeated until all of the patient's ribs have been raised. A focused effort may be placed on any region that that exhibits the greatest restriction.

Supine Techniques

Mobilizing the Ribs

This is rib raising coordinated with patient respiration. If the patient cannot lie completely flat, these procedures may be performed by elevating the head of the bed or emergency room stretcher to a more comfortable angle. These techniques are useful in the acute asthmatic patient, who reacts with further increased difficulty in breathing, even when very light pressure is applied to the rib cage. These techniques may be adapted to both pump and bucket handle motion. It is best to begin in the area of greatest rib restriction and continue up and/or down the entire thorax until all ribs are treated. By coordinating the procedure to the patient's respiratory rhythm, you can avoid any challenge to the patient's breathing. Used in this way, any of these treatment techniques will immediately lessen the patient's work of breathing, and can be used even in patients with the most acute respiratory problems.

Direct Method

Bucket Handle Ribs

This technique is most useful for lower rib restrictions.

Position

1. The patient is supine. The operator is at the side of the table, facing the patient.
2. The physician's fingerpads of the cephalad hand contacts rib angles posteriorly and the fingerpads of the caudad hand contact costochondral junction on the same side. The thumbs make a broad contact with rib shafts across midaxillary line.
3. The physician monitors the patient's breathing with light finger contact until the patient's breathing rhythm is familiar.
4. Then, as the patient begins to inhale, the physician's hands turn in the same direction, moving both thumbs cephalad, exaggerating the inhalation motion of the bucket handle-type ribs.
5. As the patient begins to exhale, the physician's hands also turn in the opposite direction to exaggerate the exhalation motion of these ribs.

Note: The entire hand and palm should be in contact with the rib cage to broaden surface area of contact.

Pump Handle Ribs

Position

1. The patient is supine. The operator is seated at side of the table, facing the patient.
2. The physician's fingerpads of the cephalad hand contacts a pump handle rib posteriorly at its rib angle.
3. The physician's caudad hand contacts the same rib anteriorly with its fingerpads across the rib's costochondral junction. The palm of this hand is lifted to avoid the breast of a female patient.
4. The physician monitors the patient's breathing with light finger contact until the rhythm of the patient's breathing is familiar.
5. As the patient begins inhalation, the physician's caudal fingerpad contacts move superiorly while the fingerpad contacts of the cephalad hand simultaneously move inferiorly to exaggerate the inhalation motion of the pump handle rib.
6. As the patient begins exhalation, there is reversal of the physician's hand movements to exaggerate the exhalation motion of the pump handle rib.

Indirect Method Treatment

Rib Raising

This method is described here for a single rib dysfunction, although it may be applied to a group of ribs.

Position

1. The patient is supine. The operator is at the side of the bed or table, facing the patient.
2. The fingerpads of the index and/or middle fingers of the physician's cephalad hand contact the restricted rib posteriorly across its angle.
3. The physician's index and/or middle fingers of the caudad hand contact the same rib anteriorly across the patient's costochondral junction.
4. The physician's thumb pads should contact the shaft of that rib at its midaxillary line for added control.
5. The patient's inhalation and exhalation is monitored as the physician gently encourages the rib to move in the direction of its freedom. This is carried to the point of ligamentous balance (point of greatest ease) and held there.
6. Adjustments in cephalad/caudad, anterior/posterior, and traction/compression may need to be carried out by passive motion testing and added to bring about the best balanced positioning of the rib.
7. Respiratory cooperation may be added by asking the patient to hold their breath in the direction associated with the greatest freedom.
8. The positioning is held in ligamentous balance until release is felt.

9. The rib motion is reevaluated during active inhalation and exhalation.

Sternal Mobilization

The mediastinal fascia is continuous with the fibrous pericardium of the heart and central tendon of the diaphragm. The fibrous pericardium of the heart is attached to the sternum via the superior and inferior sternopericardial ligaments. A sternal release may be used to mobilize this important fascial mechanism.

Position

1. The patient is supine. The operator is seated at the head of the table.
2. The physician's caudad hand contacts the sternum and manubrium and the palm of their cephalad hand is placed posteriorly across the patient's spinous processes, approximately in the T1-6 region.
3. The physician's sternal contact moves the patient's sternum through its six motions—superior, inferior, lateral to the right, lateral to the left, clockwise rotation, and counterclockwise rotation—determining its directions of restriction in motion.
4. The hand of the physician's spinal contact will always be moved in the direction that is opposite to the sternal restrictions.
5. As the patient continues to breathe normally, each sternal preference is held at its motion barrier until release occurs. Rather than doing each motion separately, the sternal restrictions can be taken to their restrictive barrier and each "stacked upon the other" and the composite held until release occurs.

Note: This can also be performed as an indirect method technique. To do this, the sternal motions are stacked, or each is separately carried to the point of ligamentous balance and held at that balance while intrinsic forces release the dysfunction. Respiratory force can be added to hasten release by having the patient hold their breath in the phase that produces the *most* ligamentous relaxation.

Abdominal Treatment Techniques

The abdomen follows the principle that the shape of a container will affect the function of its contents. The abdomen has a roof, a floor, and anterior and posterior walls. The diaphragm is the roof of the abdomen; the liver, spleen, and supporting mesenteries are suspended from it. The pelvic diaphragm is the floor. It supports the abdominal and pelvic viscera, along with the shelf created as the posterior abdominal wall crosses the pelvic brim. The iliopsoas and quadratus lumborum make up the posterior abdominal wall. The insertion of iliopsoas on the lesser trochanter of the femur involves the hip in abdominal and pelvic function. The aforementioned structures are usually treated before directly treating viscera. The autonomic relationships and lymphatic drainage of the abdomen and pelvis should also be considered.

Direct Hip Release

Position

1. The patient is supine. The operator is at the side of the table on the side of the leg to be treated.
2. The physician's cephalad hand contacts the patient's hip behind the greater trochanter for monitoring.
3. The physician's caudad hand holds the leg so it can be maneuvered.
4. The physician's caudad hand induces abduction/adduction and internal/external rotation to find the point of balanced tension of the hip joint.
5. While monitoring with the cephalad hand, the physician's caudad hand places the patient's ankle into the axilla to control the patient's leg position. The caudad hand then moves up to or above the knee to create a fulcrum.
6. The distal part of the patient's extremity is taken medially to create lateral traction at the femoral head and held in that position.
7. When lateral release is felt, the physician applies inferior traction on the patient's leg and holds that until another release is felt.

Pelvic Diaphragm Release

Position (Fig. 71.6)

1. The patient is in the lateral recumbent position with the legs and knees flexed. The operator stands behind patient. This may also be done with the patient in the supine position with the operator standing by the patient on the side that is to be treated. *The operator should explain the procedure to the patient and that a contact will be made near an intimate area before proceeding.*
2. The extended fingers of the physician's caudad hand contact the ischial tuberosity of the patient on the side up off the table. The fingers are then moved at a point that is just medial and slightly caudad to the tuberosity; the fingerpads may stay in contact with the medial aspect of the tuberosity.
3. The physician's fingertips and rigid fingers are then gently but firmly advanced, medial to the sacrotuberous ligaments, into the ischiorectal fossa until the resistance of the pelvic diaphragm (on that side) is initially palpated.
4. At that point the excursion of the pelvic diaphragm is monitored during the patient's respiratory efforts.
5. Then the fingers are held at the point of tissue tension (*not lifted to produce more tension*). They simply resist the downward movement of the pelvic diaphragm that occurs as the patient inhales slowly and deeply.
6. The physician's fingers follow the pelvic diaphragmatic tension cephalad as the patient exhales slowly and completely.
7. Steps 5 and 6 are repeated until the maximal amount of diaphragmatic lift (muscular tension release) has occurred.
8. The patient is turned to the opposite lateral recumbent position. With the physician behind the patient, the other half of the pelvic diaphragm is released in a similar manner.

Posterior Abdominal Diaphragmatic Releases

Releasing the Lumbar Spine/Crura

Position

1. The patient is supine and the operator is at the side of the table facing the patient.
2. The physician evaluates T12 to L3 for somatic dysfunction or increased paraspinal tissue tension.
3. The physician then contacts the spinous processes on either side of the vertebral unit that has somatic dysfunction.
4. The vertebral unit is moved in directions that exaggerate its freedom of motion–flexion/extension, rotation, and right or left side bending.
5. These directions of freedom may be individually held at their point of ligamentous balance or each direction of motion preference might be stacked, one-upon-the other, and released.
6. Release occurs as the tissues are held at their point of ligamentous balance.
7. Respiratory effort of the patient may be added to hasten the release. This is performed by asking the patient to hold their breath in the respiratory cycle that is sensed to be accompanied by the greatest relaxation of the tissues.

Releasing the 12th Ribs/Arcuate Ligaments

Position

1. The patient is supine. The operator is at the side of the patient to be treated.
2. The physician contacts the patient's 12th rib near mid-shaft. *Note:* Doubling the finger contact may provide better control. Remember, the 12th rib does not have a rib angle.
3. The physician applies traction to the 12th rib in a direction between horizontal and the direction of the long axis of the 12th rib; settle on the composite direction that maximizes the perception of "tension in the lumbocostal arches," matching the traction force with resistance found in the tissues.
4. The rib is held in this position of traction until release is felt. This may occur as a change in the long axis of the rib rather than just a simple decompression.
5. The physician walks to the other side of the patient and the technique is repeated for the other 12th rib.

Anterolateral Abdominal Diaphragm Releases

Position

1. The patient is seated. The operator stands behind patient.
2. The physician reaches around the patient and contacts the soft tissues just below the costal margin (chondral masses) with the fingerpads of both hands.
3. The patient is asked to slouch as the physician supports the patient's back with their chest. This allows the physician's fingers to advance medially and superiorly around the costal margin.
4. The excursion of the abdominal diaphragm during respiration is monitored.
5. The physician's finger placements gently resist the downward motion of the diaphragm as the patient inhales and follows the diaphragm superiorly as the patient exhales. Note: *Do not push upward against the diaphragm.*
6. Step 5 is repeated, as the patient continues to take slow, deep breaths, until a release is felt.
7. The fingers of the physician's hands are then moved medially or laterally until the entire anterolateral surface of the diaphragm has been treated.

Abdominal Lifts

Abdominal lifts provide a safe, simple means of addressing ptosis and congestion of the abdominal viscera and its mesenteries. More specific treatment techniques for the viscera should not be attempted until palpatory skill and anatomic familiarity of the abdomen has been studied and achieved.

Position

1. The patient is supine with the knees bent to 90 degrees and the feet are flat on the table. The physician stands at the side of the patient that is to be treated.
2. The physician contacts the lower left quadrant of the abdomen just superior to the inguinal ligament and gently inserts the fingerpads into the patient's abdomen.
3. The physician then gently lifts the patient's abdominal contents obliquely toward the right upper quadrant until slight tension is palpable.
4. The tissues are then held in this position until a release is felt and the contents can be moved slightly further toward the patient's right upper quadrant. *Note:* The physician should be attentive so that the lift occurs to the internal organs and that they are not just lifting the anterior abdominal wall.
5. Steps 3 and 4 are repeated until the patient's maximal release has been accomplished.
6. For the right lower quadrant, repeat steps 1–5, lifting vertically towards the *right* upper quadrant.

Note: A minor vibration may be transmitted to the abdomen by the physician's finger contacts and be substituted for the lift. Also, respiratory force may accentuate and hasten the release of a lift. Respiratory force is instituted by asking the patient to take a partial breath in and hold it until they have to breathe. Just as the patient has to take the breath, the physician will notice a release of the tissues.

Lymph Mobilization

Stimulating the Movement of Lymph

Osteopathic treatment to enhance lymph flow is described elsewhere in this text. In this chapter, the concept of interstitial fluid fluctuation was introduced in relation to lymph formation and flow. Techniques to stimulate the formation of lymph using this principle were taught by Anne Wales, DO, and will be presented here as an addition to those presented in Chapter 70. The respiratory mechanism, as well as any areas of restriction along the course of drainage should be treated before stimulating the formation and movement of lymph.

Osteopathic treatment designed to stimulate formation and movement of lymph is based on an understanding of the physiology and mechanics of lymph formation and propulsion. A limiting factor in lymphatic drainage is the movement of fluid from the interstitium into the initial lymphatic vessels. This is the formation of lymph. There are no inherent hydrostatic or osmotic gradients to drive this process. Fluid fluctuation and rhythmic movement in the immediate environment of the initial lymphatic vessels forms lymph. These actions form the physiologic basis for most of the following lymphatic techniques. Successful treatment depends upon creating a rhythmic fluctuation of extracellular fluid. This movement of fluid can be palpated and monitored from the hand contact on the patient, and must be differentiated from the tissue movements monitored during treatment on the musculoskeletal tissues. The movement of the body's fluids in response to the treatment is the key.

Propulsion of lymph is dependent on several factors. Stretch receptors located in the distal end of lymphatic vessels, responsive to the formation of lymph, begins the peristaltic contraction of smooth muscle in the wall of the lymph vessels. The thin and pliable lymphatic vessels are also responsive to external pressures, such as skeletal muscle contraction in muscle adjacent to the vessel. The relative importance of these factors differs in different areas.

Lateral Fluctuation at the Knee

Position

1. The patient is supine. The physician stands at the side of the patient to be treated.
2. The physician flexes the patient's knee to 90 degrees and the hip to 45 degrees; the patient's foot is resting flat on the table.
3. The physician's caudad hand gently holds the dorsum of the patient's foot and ankle.
4. The physician's cephalad hand rests on top of the patient's knee.
5. The physician gently moves the patient's leg medially and laterally at the knee to find the position of greatest ease.
6. At that point of ligamentous balance, a small medial, lateral excursion is initiated and maintained.

Lateral Fluctuation at the Forearm

Position

1. The patient is seated. The physician sits facing the patient.
2. The physician grasps the hand of the patient on the affected side as if to make a handshake.
3. The physician's other hand supports the patient's elbow, keeping it at 90 degrees.
4. The patient's forearm is supinated and pronated to find the point of greatest ease.
5. From this point of ligamentous balance, a gentle, rhythmic pronation/supination excursion is initiated to fluctuate fluid

Abdominal Lymph Stimulation

The abdominal lymphatics reside in the mesenteries of the abdomen. Dr. W.G. Sutherland described the use of a transmitted vibration to stimulate the movement of abdominal and thoracic lymph. The effect of the vibration is to produce a wave like that produced by a pebble landing in the center of a pond. The transmitted vibration to the abdomen will also act to lift the mesenteries in a very gentle manner. This can be useful in acute situations, such as the immediate postoperative period. These specific techniques were demonstrated by Dr. Wales and are based on this concept.

Position

1. The patient is supine with knees bent to relax the abdominal wall. The physician stands at the right side of the patient.
2. Physician contacts the patient's left lower abdomen just superior to the inguinal ligament, placing one hand over the other.
3. The tissues are gently lifted superomedially until the first sense of resistance is palpable.
4. A transmitted vibration is directed toward the cisterna chyle–a point that would be approximately posterior to halfway between the xiphoid process and the umbilicus, slightly to the right of center. This point will be approximately perpendicular to the suspension of the mesentery of the descending colon.
5. A palpatory sense of decongestion or lift of the mesenteries indicates successful treatment.
6. The physician walks to the left side of the patient and contacts the right lower abdomen in the same manner and steps 3 through 5 are repeated for the right side of the patient.

Thoracic Duct Technique

Dr. Sutherland likened the thoracic duct to a siphon, indicating a functional significance to the turn located at its superior end, that allows it to drain downward into the superior aspect of the subclavian vein. The thoracic duct may be stimulated with a transmitted vibration at its proximal and distal ends.

Position

1. The patient is supine and the physician stands at the right side of the patient.
2. The physician contacts the patient's abdomen just below the costal margin and to the right of center, in the area overlying the cisterna chyle. Use the contact of one-hand-over-the-other- hand.
3. The physician induces a transmitted vibration directed toward the cisterna chyle.
4. Then the physician contacts the left axilla at the second or third intercostal space, near the midclavicular line, using the one-hand-over-the-other-hand contact.
5. The physician transmits a vibration of tissues directed posteriorly and slightly laterally.
6. A perceived change in the quality of the deep tissues or a sense of decongestion may become apparent as the treatment proceeds.

CONCLUSION

The osteopathic treatment of the acutely ill hospitalized patient is designed to support and enhance the underlying physiology of a patient as they recover from an illness or other severe stress. Care must be taken to insure that the treatment is appropriate and within the physical capabilities of the patient to respond appropriately. Specialist level intervention may be indicated in unusual and challenging cases, but many cases can be treated effectively by osteopathic physicians, residents, and students if the principles described in this chapter are followed. The structural examination findings, along with knowledge of the pathophysiology of the disease process and individual patient's condition, are combined to form a unique treatment plan for each patient, at each visit.

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