Table 10.20. Functional Excursion Axiom

With *symmetrical* muscle tightness *be aware...*
With *asymmetrical* muscle tightness *beware.*

warrant investigation. These deficiencies may result in an accentuation of sagittal plane, primary and secondary curves (i.e., cervical/lumbar lordosis, thoracic kyphosis), and the development of postural dysfunctions such as forward head posture (FHP), cervical and thoracic dowager's deformity, and thoraco-lumbar kypholordosis. Asymmetric tightness or loss of functional excursion in paired muscle groups, however, demands the utmost of evaluative scrutiny. This is chiefly because asymmetric muscle length in paired groups may create alteration in the coronal plane with rotational or torsional forces imposed on the pelvis, vertebral column, and rib cage. These forces may result in the presence of non-neutral mechanics in the vertebral column and the increased risk of myofascial and articular dysfunction. An axiom to follow when evaluating functional excursion is presented in Table 10.20.

Muscles are evaluated by taking their associated sites of origin and insertion through patterns of movement that functionally lengthen the appropriate tissues. As all osteokinematic movements in the extremities occur in curvilinear or elliptical arcs, movements should be directed with care and consideration for these pathways. Osteokinematic motions should include straight planar (i.e., sagittal, coronal) patterns of movement as well as combined patterns to create functional, diagonal patterns. In addition, movements should be performed with careful observation given to barriers of increased resistance within an overall range of excursion. Total range may belie minute yet significant restrictions in the myofascial unit and only be identified through visual and palpatory means during actual functional excursion.

Functional excursion should also be assessed through active and resisted movements where possible. Palpation of relative muscle bellies and musculotendinous and tenoperiosteal junctions should be performed throughout movements of functional excursion to identify specific points or sites of maximal restriction. These sites will frequently be the starting place for treatment (Fig. 10.20).

Figure 10.20. Evaluation of functional excursion with concurrent palpation of the pectoralis major muscle to identify specific dysfunctional tissue barriers.

Neuromuscular Responsiveness and Control

Neuromuscular responsiveness consists of the initiation, control, recruitment, strength, timing, and endurance, among other qualities, of a myofascial tissue [82]. These components are critical in achieving proper function of the related articular structures and kinetic chain as a whole. This is particularly true in the case where the chronicity of somatic dysfunction has significantly affected the neuromuscular attributes of the myofascial tissues associated with articular dysfunction.

Assessment of the neuromuscular responsiveness and control of a myofascial tissue can be accomplished through the use of proprioceptive neuromuscular facilitation (PNF) patterns [38, 39, 82]. In the thoracic spine and rib cage, shoulder and pelvic girdle patterns (Table 10.21) are a valuable tool for both evaluation and treatment strategies. Guidelines for effective monitoring and administration of these patterns are also provided (Table 10.22).

Table 10.21. PNF Patterns of Assessment for Neuromuscular Responsiveness and Control

Anterior elevation	Posterior elevation
Anterior depression	Posterior depression

Source: Adapted from G Johnson, V Saliva. PNF-I: The Functional Approach to Movement Reeducation. San Anselmo, CA: The Institute of Physical Art, 1987.

Table 10.22. Guidelines for Effective Administration and Monitoring of PNF Patterns

Provide complete tension at lengthened ROM without strain to cervical or thoracic components.
Allow minimal trunk motion during pattern.
Motion should remain in a straight diagonal with an arc component.
Motion proceeds from a superior to inferior, anterior to posterior direction, or vice versa.
The head of the humerus should cross the midline.

Source: Adapted from G Johnson, V Saliva. PNF-I: The Functional Approach to Movement Reeducation. San Anselmo, CA: The Institute of Physical Art, 1987.

Principles of the Treatment Approach

Management of somatic dysfunction of the thoracic spine and rib cage requires a multifaceted, eclectic approach with careful attention paid to the objective findings enumerated in the evaluative process. In addition, several guidelines for treatment may be helpful in directing both the novice and experienced practitioner. These guidelines are provided in Table 10.23.

Be Guided by Objective Findings

Treatment must always be guided predominantly by objective findings rather than subjective presentations. Pain in the thorax is most ubiquitous and confusing, because virtually all somatic structures possess at least three spinal levels of innervation [53, 90]. In light of this, applying treatment with a palliative methodology based on subjective direction by the patient is most futile. In addition, differentiation of the various pain presentations (i.e., superficial spondylogenic, deep spondylogenic, neurogenic, radicular, viscerogenic, psychogenic), although possible and important, will provide little in the way of treatment direction. Instead,

Table 10.23. Treatment Guidelines

Be guided by objective findings rather than subjective complaints.
Treat motion dysfunction versus positional dysfunction.
Sequence treatment in order of maximal motion loss according to dysfunctional tissue end-feel or barrier.
Never barge a barrier; however, once "one has a foot in the door, never lose it."
Use the least force possible to effect the desired change.
Clear compensatory somatic dysfunction following primary dysfunctions to avoid recidivism.
Reevaluate following each procedure ("onion skin concept").

Source: JJ Ellis. LPI—Lumbo-Pelvic Integration. A Course Manual. Patchogue, NY, 1990.

the manual practitioner should trust in the observation and identification of specific and reproducible objective findings (i.e., positional and motion).

Treat Motion Dysfunction Versus Positional Dysfunction

Because function follows form and form is determined by function, it is imperative that treatment be guided toward the restoration of appropriate motion and not be guided by apparent positional findings in and of themselves. Positional findings frequently present as the end-result of aberrant myofascial function. In addition, the presentation of aberrant positional findings in the absence of motion loss may belie bony anomalies with relatively normal arthrokinematics.

Sequence Treatment in Order of Maximal Motion Loss

Although numerous axioms and strategies for treatment progression exist in the osteopathic literature [1, 35, 36], perhaps the most significant driving principle is the administration of treatment through a sequence that identifies the areas of maximal motion loss in accordance with dysfunctional tissue end-feels. This may include myofascial, articular, and, at times, visceral structures. This is particularly true in the thorax, where the rib cage provides attachment for numerous myofascial and visceral structures that often provide the primary barrier in motion restriction. Departure from a traditional progression is often warranted in this area because the costal segments and their associated myofascial structures, particularly where chronicity prevails, provide an environment for aberrant function of the thoracic vertebral segments. An example of this is the case where both a type II non-neutral ERS dysfunction and an external rib torsional dysfunction exist concomitantly. In accordance with the traditional biomechanical model, the thoracic vertebral dysfunction would be addressed first because this is seen as primary and the cause of the associated external torsion dysfunction [1, 35, 36]. This, however, may not be the most judicious approach, especially where chronicity prevails. In this example, the costal segment's chronic aberrant position is frequently associated with significant myofascial dysfunction of the related intercostal muscle groups and related connective tissue. Attempting to address the thoracic vertebral segment first may not only prove unsuccessful, but may with repeated attempts create iatrogenically induced instability in the costovertebral and costotransverse articulations. The costal segment, acting like an anchor (secondary to MFD), provides an environment where correction of the thoracic vertebral dysfunction is unattainable until an environment (of the myofascial tissues) is provided in which correction can occur and be maintained. Departure from previously learned sequences that emphasize articular technique is not only prudent in this case, but necessary if success is desired. However, a combined articular technique that addresses the costovertebral and costotransverse articulations is often effective (see Chapter 9).

Never Barge a Barrier

The application of manual therapy procedures, particularly in the myofascial tissues, demands the utmost of sensitivity and respect for patient tolerance. Aside from recognition of a tissue's reactivity and its relative stage of repair (i.e., inflammatory, fibroblastic, or remodeling stage), the patient's tolerance of treatment depth and progression must be considered. This is particularly true in the presence of increased muscle holding or tonicity. Progression of treatment must be accomplished with acute awareness of the patient's response to treatment. As the attainment of increased depth is attempted through subtle yet progressive tissue deformation, the patient's response should be carefully monitored, both verbally and somatically. Progression or depth should never substitute for patient tolerance and comfort. Once additional depth or "ground" is achieved, however, all attempts should be made to maintain that ground, keeping in mind the adage, "never pay for the same real estate twice."

Least Force Possible

The implementation of actual technique should be delivered with the least physical force possible to effect the desired somatic change. This necessitates an exacting diagnosis, enumeration of specific myofascial and articular findings, the identification of specific barriers (i.e., depth, degree, direction), and the precise localization of those barriers. Treatment should be directed at these specific barriers, with increased force being reserved as a last option. The angulation of hand contacts, use of an assisting hand, position of the body part being treated (i.e., shortened or lengthened position), and the use of associated oscillatory motions are alternative strategies that should be considered before increased force is used. Communication between the patient and practitioner will prove valuable as the patient is encouraged to assist in both the identification of the barriers and in the process of mobilizing soft tissues. In addition, patients are encouraged to report subjective changes experienced during the treatment process. This will aid them in localizing and treating these same restrictions in their own home program.

Clear Compensatory Somatic Dysfunction

Effective management of somatic dysfunction of the thoracic spine and rib cage requires thorough assessment of and amelioration of compensatory dysfunctions that exist concomitantly with the primary dysfunction. According to the biomechanical model methodology, this compensatory dysfunction may respond and correct itself concurrently with the normalization of the primary dysfunction. However, where chronicity prevails, such compensatory dysfunctions (particularly myofascial) may require specific attention. In addition, compensatory dysfunction, especially where it is associated with myofascial dysfunction, may create an environment where normalization of primary dysfunction will not occur, or where there exists a predilection for a recurrence of that dysfunction. This is seen in a patient with a chronic type II non-neutral FRS right dysfunction of T5 with a compensatory neutral type I rotoscoliosis above at T1–T4 (side-bent to the left, rotated to the right), cervical spine side-bending to the right, and subcranial sidebending back to the left. With attention focused on correction of the type II FRS dysfunction and then the thoracic type I dysfunction, the cervical and subcranial dysfunctions often are left untreated. Myofascial dysfunction of this region may provide an environment of altered posturing in the coronal plane and for non-neutral mechanics to dictate in the upper thoracic region. Although type I neutral dysfunctions are not commonly recognized as the primary dysfunction, in this case, they may provide the biomechanical prerequisites for recurrence of the type II dysfunction.

Re-Evaluate After Each Procedure

An axiom for all manual therapy procedures includes re-evaluating after each corrective procedure. Because this therapeutic intervention is "corrective versus palliative" in definition and intent, objective variables defined in the evaluative process must be continually reassessed. The normalization of myofascial dysfunction associated with vertebral and rib dysfunction frequently has profound effects on the overall presentation of that somatic dysfunction. Evaluation should focus on the positional and motion characteristics of the region being treated and include palpation of related bony landmarks and myofascial structures and the administration of one or two relative motion tests. Although re-evaluation should include the monitoring of subjective complaints, an emphasis should not be placed on this in the re-evaluation.

Principles of Myofascial Techniques

The successful administration of soft-tissue mobilization (STM) requires a keen sense of both patient and tissue response. This response is monitored through a variety of senses, including sight, palpation, and auditory feedback. Constant reassessment and adjustment of contacts, including localization, duration, and force, as well as patient positioning and assistance with the treatment technique are required for a successful outcome. In addition, a variety of soft-tissue mobilization techniques and strategies by which to implement them contribute to the success in this endeavor.

Contacts

Numerous contacts may be used during STM and commonly include the tips of the digits, the thumb, the pisiform, the open palm, the forearm, and the elbow. Determination of which contact is used depends largely on practitioner comfort, the body part being worked on, and the dexterity and skill of the practitioner administering treatment.

Depth

Localization of the treatment contact to the dysfunctional tissue barrier is imperative for success in myofascial mobilization. Barriers must be engaged with respect to tissue depth and direction of the restriction, with localization maintained throughout the technique. Depth is obtained through the judicious use of force, contact angulation (vertical versus horizontal), and the positioning of associated myofascial tissues in a shortened position. Angulation of the contact will determine the depth of a technique and should always be used before increasing force. As with the evaluative process, the more vertical the orientation of a contact, the greater the depth achieved. Positioning adjacent soft tissues in a shortened position decreases tissue turgor and tension and will allow greater penetration. Identification and maintenance of appropriate tissue depth often proves most challenging for practitioners new to STM; however, they are critical for success. Relocalization to the new barrier must occur throughout each specific technique.

Duration

In accordance with the viscoelastic properties of connective tissue, there is a specific time dependency for the elongation of collagen and elastin fibers [48, 52]. This time may vary depending on the viability and conditions of the soft tissues being treated. Various clinicians have attempted to outline specific time frames for treating a specific myofascial restriction. These range from 10 seconds to 90

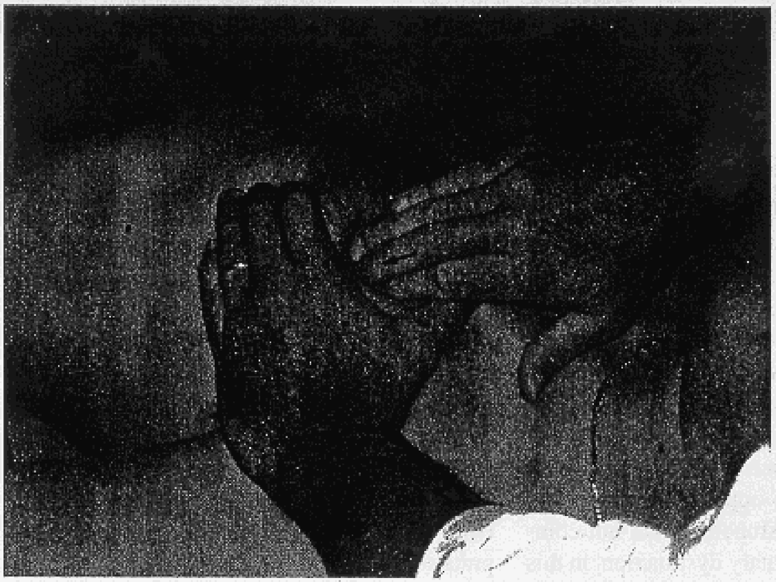

Figure 10.21. Soft-tissue mobilization of the superficial clavipectoral fascia in a shortened position.

seconds [29, 30, 79, 91]. Perhaps a more functional approach, and the one we endorse, is to apply treatment while concurrently evaluating and assessing the response of the treated and surrounding soft tissues. Instead of dogmatically assigning a time constraint on treatment, duration is based more dynamically on ongoing tissue response. Changes in tissue density (i.e., softening, elongation), turgor, tone, and elasticity (particularly with respect to end-feel) are noted as significant and warrant continued efforts. If after two to three attempts with a particular technique no noticeable change is perceived, consideration should be given to other sources as being primary or causative.

Force of Technique

As with most manual therapy procedures, force is never a substitute for accuracy or specificity of localization or for an appreciation of ductile (time dependant) properties of myofascial tissue. In STM, forces used should be only those that allow for dysfunctional tissue barriers to be engaged and corrected in accordance with their time-dependent nature of motion. Force should also be sufficient enough to maintain engagement of a barrier throughout the technique. As elongation or softening of a dysfunctional tissue barrier is perceived, the path of release should be followed.

Patient Positioning

Patient positioning should incorporate positioning the involved tissues and respective body parts in one of three static positions—resting neutral, shortened range, or lengthened range—and through various dynamic postures.

Static Postures

In the resting, prone-neutral position, the lumbopelvic girdle is in a soft lordotic position with a pillow or towel under the abdomen. The shoulders are supported to eliminate protraction, while the forehead (i.e., the table face cutout is used) and the ankles are supported. The emphasis is on attaining an environment of comfort, while reducing the cervicothoracic and thoracolumbar curves.

In the shortened position, respective tissues are placed in a slackened range by altering the surrounding tissue (at the same level) or through the positioning of a related bony or articular segment. This strategy provides an environment that dampens the feedback from surrounding myofascial structures and often allows the most efficacious palpation of the dysfunctional tissue barrier (Fig. 10.21).

Treatment with tissues in the shortened range is followed by progressing to the resting neutral position and finally into the lengthened range. In the

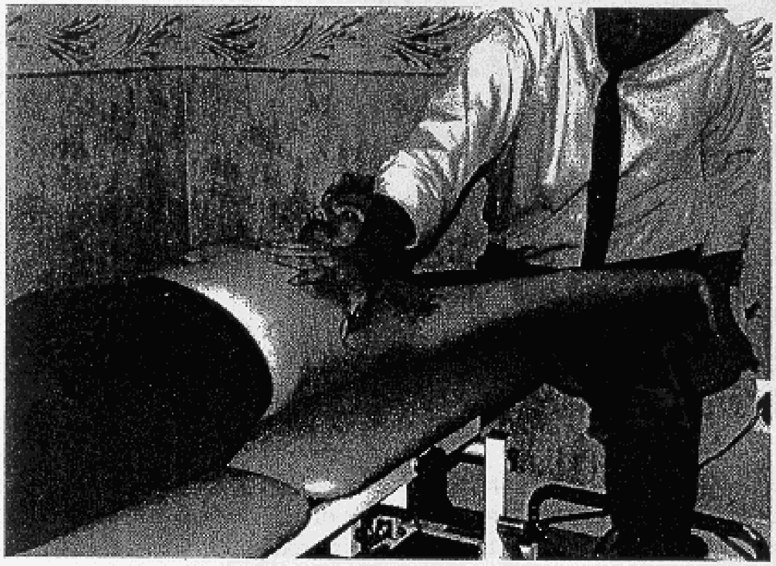

Figure 10.22. Parallel soft-tissue mobilization technique to the latissimus dorsi muscle group in a lengthened range.

lengthened range, respective tissues are placed in a position of increased tension or length by altering the surrounding tissues (at the same level) or a related bony or articular segment (Fig. 10.22).

This strategy attempts to maximize and concentrate surrounding tissue tension forces to the dysfunctional tissue barrier. Treatment progression most often concludes with the lengthened range and should be used to ascertain complete resolution of the myofascial dysfunction. These postures may be assumed through the use of such props as pillows, wedges, physio or Swiss balls, and adjustable, sectioned tables.

Dynamic Postures

Treatment of any myofascial tissue should include the use of both static and dynamic postures. As with assessment, treatment may be accomplished during dynamic movement patterns of the trunk or related extremity and should include engagement of the dysfunction tissue barrier, maintenance of localization and mobilization force throughout the movement, and a progressive increase in the tolerable amplitude of movement. These movements may include classic osteokinematic motions, or they may incorporate passive, associated oscillations of the trunk or body part. These oscillations, produced through a rhythmic rocking, most commonly at the pelvis, shoulder, or rib cage, may be inhibitive, if slow and rhythmic, or facilitory, if fast and erratic.

Patient Assistance

When appropriate, patients should be actively involved in the treatment process. This is accomplished in several ways. The patient may be asked to contract or relax an area, provide appropriate resistance (isometric, concentric, eccentric), or to provide assistance through alternative methods such as inhalation/exhalation and coughing efforts. Each of these options provides an opportunity for greater localization of forces and more effective mobilization of dysfunctional tissue barriers. In addition, when effective, patients are encouraged to use similar strategies in their home programs.

Selected Myofascial Mobilization Techniques

During the application of STM, both hands of the practitioner participate, with one designated as the mobilizing or treating hand and the other as the assist hand. This allows for specificity of localization and the option of dynamically lengthening or shortening surrounding tissues, as well as incorporating associative oscillatory forces. A variety of specific mobilization forces are available for use with the

Figure 10.23. General soft-tissue mobilization technique to the superficial fascia of the posterior cervicothoracic junction.

mobilizing or treating hand, while the assisting hand controls the immediate tissue environment. The mobilizing hand is used to engage the dysfunctional tissue barrier through a pushing force (push) or a pulling/hooking force (pull). These mobilization forces are directed at the site of maximal restriction and may be delivered as sustained pressure, a perpendicular mobilization effort, end-range oscillation, a strum, or parallel mobilization technique [29].

General Junctional Release Techniques

Type II non-neutral vertebral dysfunctions and accompanying rib dysfunctions demonstrate a predilection for occurring at junctional areas of the vertebral column (i.e., occipitoatlantal, cervicothoracic, thoracolumbar, and lumbopelvic junctions). Myofascial dysfunction is also frequently encountered at these levels. General junctional release techniques provide a quick screen and clearance approach to the skin and the superficial and deep fascia of these regions before MET or mobilization efforts are used. Treatment consists of contacting the region with a bilateral, open palmar contact paravertebrally or in a cranial-to-caudal orientation, and then engaging the superficial or deep dysfunctional tissue barriers. This is accomplished through gentle compression, shearing tissues into the greatest restrictive barrier, and finally adding clockwise or counterclockwise rotation of the hands. Maximal tissue tension is maintained as both hands continue to shear in the direction of the dysfunctional tissue barrier. This approach is used posteriorly at the cervicothoracic and thoracolumbar junctions, and anteriorly at the clavipectoral tissues and the cervicothoracic/sternomanubrial junction (Figs. 10.23, 10.24, and 10.25).

Sustained Pressure

Sustained pressure involves engaging the dysfunctional tissue barrier (most commonly through the use of the distal tips of the digits) while carefully monitoring depth, direction, and degree of restriction, and maintaining a static force against the restriction until a change in density or length is perceived. This technique is primarily used for muscle tone problems; however, it is effective for myofascial play dysfunction as well. Patient participation is encouraged (especially when treating muscle tone problems) through the use of biofeedback-like techniques including controlled breathing, visual imagery, and active contraction/relaxation techniques. With the epicenter of the dysfunction tissue barrier engaged, the patient is encouraged to gradually inhale, further engaging the barrier, while pressure is maintained. During exhalation, the new barrier is engaged without provoking a localized response of pain or an increase in tone (Fig. 10.26). This is repeated until muscle tone is normalized.

Figure 10.24. General soft-tissue mobilization technique to the superficial fascia of the anterior cervical thoracic/sternomanubrial junctions.

Figure 10.25. General soft-tissue mobilization technique to the superficial fascia of the posterior thoracolumbar junction.

Perpendicular Mobilization

Perpendicular mobilization efforts involve engaging the dysfunction tissue barrier and then, through a series of graded mobilization efforts of varying amplitudes, deforming the respective tissues at right angles. These amplitudes may be graded similarly to those used in the articular system (i.e., grades I–V) [92, 93]. This technique is most frequently used with muscle tissue (midbelly, tenoperiosteal) and at bony contours, and is most effective with diminution of myofascial play, although it can be used in the presence of increased muscle tone (Fig. 10.27).

End-Range Oscillating Mobilization

The last phase of a perpendicular mobilization effort, end-range oscillating mobilization, is administered to myofascial tissue at the end-range of its available accessory motion. Applied in a perpendicular or transverse orientation, mobilization forces in

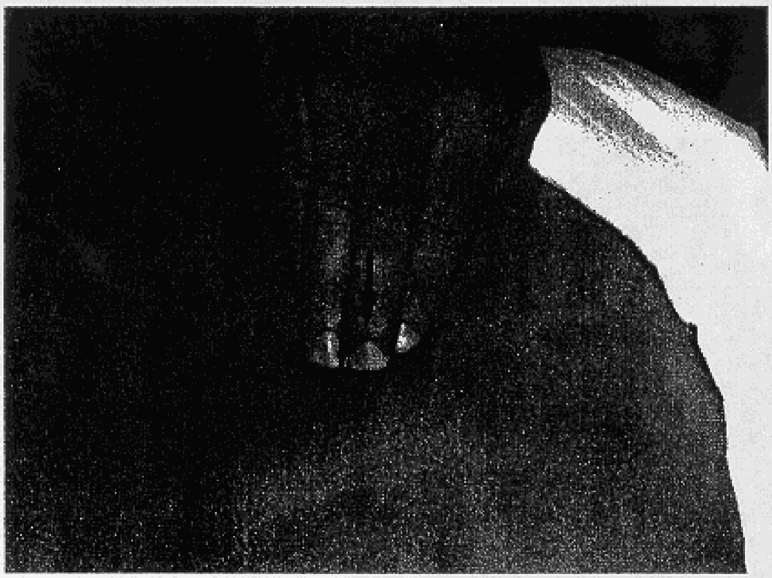

Figure 10.26. Sustained-pressure soft-tissue mobilization technique to the rhomboid muscle group.

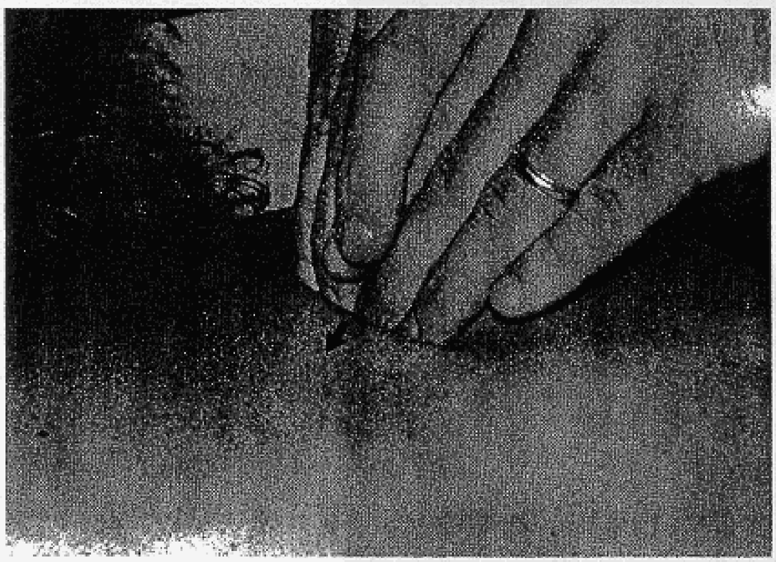

Figure 10.27. Perpendicular soft-tissue mobilization technique.

this technique are of very small amplitudes and create a transverse, end-range deformation to the site and direction of maximal tissue dysfunction. This technique is effective for both myofascial play and tonal abnormalities.

Strumming

Strumming technique incorporates a transverse mobilization effort that begins at the medial or lateral seam of a muscle belly, deforms the belly through a push or pull effort, and then strums across the belly to the opposite side without sliding over the skin. This rhythmic, synchronous movement can be used to treat both myofascial play and muscle tonal aberrations (Fig. 10.28).

Parallel Mobilization

Parallel mobilization techniques are applied between muscle belly septae, at the lateral or medial borders of a muscle, or along a bony contour. As the mobi-

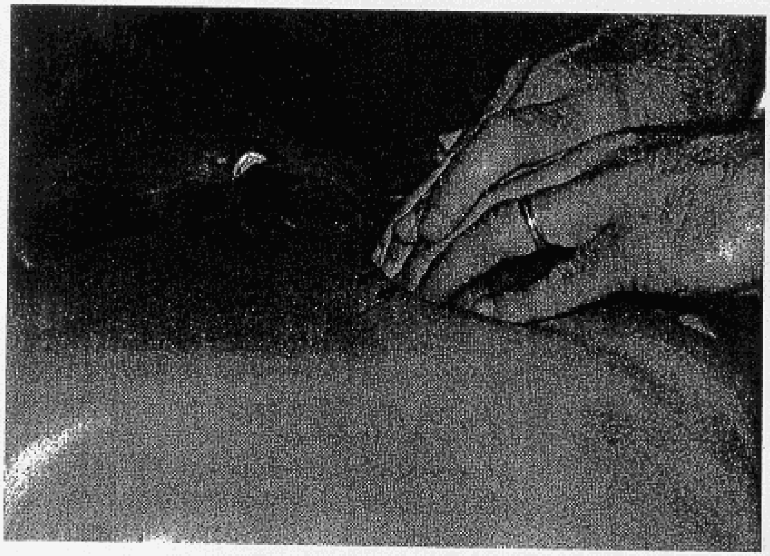

Figure 10.28. Strumming soft-tissue mobilization technique.

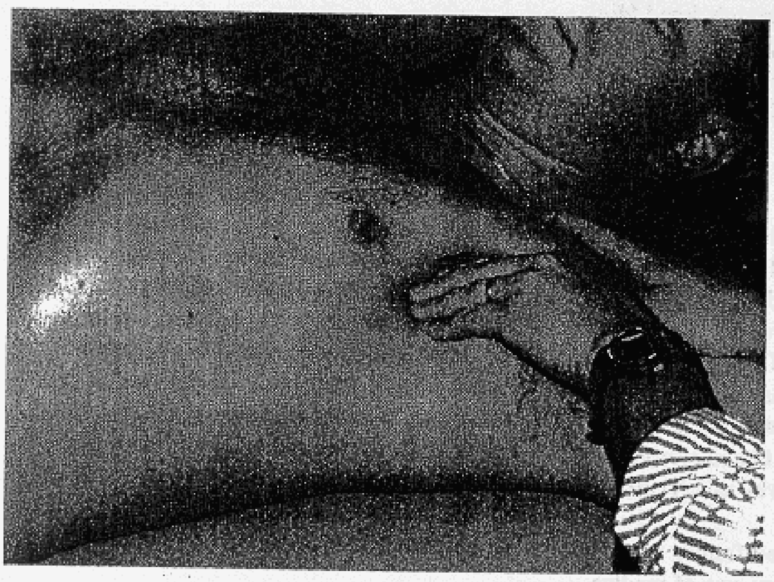

Figure 10.29. Parallel soft-tissue mobilization technique.

lizing hand or digit glides along the contour or between the septum, various angles of inclination are used to attain appropriate depth to localize and ameliorate specific dysfunctional tissue barriers. This technique is effective for both myofascial play and tonal dysfunctions (Fig. 10.29).

Functional Excursion and Muscle Length

Restoring functional excursion or length to the myofascial unit demands careful attention and cognition of that particular structure's fiber type or preponderance, orientation, relative stage of reactivity, and the osseous or articular structures to which it attaches. Myofascial structures may initially have diminished excursion in one direction. However, they may maintain a multiplanar fiber direction that, when taken through full excursion, presents multidirectional limitations. Slow, judicious, and incrementally small ranges of excursion will allow the examiner to identify and treat tissue limitations.

Specific treatment techniques for increasing excursion include static stretching [94, 95], hold-relax, contract-relax stretching [38, 82], and a combination of isotonic contractions to that particular myofascial structure (concentric, eccentric, isometric, slow reversal hold) [4, 82].

Case Studies

The following case studies illustrate the importance of identifying objective clinical findings of somatic dysfunction of the thorax. Particular attention is placed on myofascial tissues in their causal relationship of biomechanical dysfunction, as well as their potential role in promoting recalcitrant dysfunction.

Case 1

C: Chief Complaint

A 29-year-old woman reported a 6-week history of right upper quadrant and cervical pain; right greater than left episodic paresthesia in the right hand (digits 1 and 2); discomfort with all active cervical motions, most notably left side-bending; and increased symptoms on full inhalation efforts.

H: History

The patient described being injured while playing volleyball. On spiking the ball and following through, she experienced immediate cervical and right shoulder pain, which progressed to the right hand approximately 2 days later. Over a period of 1 week, the pain continued to increase in intensity and was present during examination with all inhalation efforts, with numbness in the right hand reproduced and increased with inhalation as well as left cervical side-bending efforts.

The patient denied any related family history, past mechanical or medical history, use of medications, or prior treatment for this condition. Her occupational history appeared noncontributory in the development of this dysfunction.

A: Asymmetries of Bony Landmarks

The key asymmetric findings for this patient included:

1. Elevated first rib on the right.
2. A type II non-neutral FRS left dysfunction at T1.
3. A type II non-neutral FRS right dysfunction at T2.

R: ROM/Mobility Testing

Positive findings on key motion tests for this patient included:

1. Confirmation of the type II non-neutral FRS left and FRS right dysfunctions at T1 and T2 (with diminished extension, side-bending, and rotation to the right at T1 and diminished extension, side-bending, and rotation to the left at T2).
2. Diminished caudal spring testing to the first rib on the right with firm, arresting, reactive end-feel.
3. Aberrant respiratory motion of the right upper rib cage on full exhalation.
4. Diminished active cervical range of motion, with side-bending left 75%, rotation right 50%.

T: Tissue Texture/Tension/Tonal Abnormalities

The key tissue abnormalities for this patient included:

1. Significant increase in tone of the right anterior and medial scalenes, right sternocleidomastoid, and right levator scapulae musculature.
2. Diminished mediolateral muscle play of both of the right anterior and medial scalenes at their respective musculotendinous and tenoperiosteal junctions.
3. Diminished mediolateral muscle play of the right sternocleidomastoid muscle at the mid-belly, with poor disassociation from the underlying anterior and medial scalene muscles.
4. Decreased functional excursion of the right anterior and medial scalene and right levator scapulae muscles.

S: Special Tests

Special tests for this patient revealed:

1. Positive radiologic evidence of a mildly cranially displaced first rib on the right.
2. Positive adverse neural tension signs in the right upper extremity with combined right upper ex-

tremity abduction, external rotation, and wrist and finger extension.

3. Increased subjective complaints of pain and paresthesia with concomitant cervical side-bending left and rotation right, or with full inhalation efforts.

Musculoskeletal Diagnosis

1. Elevated first rib on the right.
2. Type II non-neutral FRS left dysfunction at T1.
3. Type II non-neutral FRS right dysfunction at T2.
4. Myofascial dysfunction of the right anterior and medial scalenes (increased tone, decreased play, and functional excursion), right sternocleidomastoid (increased tone, decreased functional excursion), and levator scapulae musculature (decreased functional excursion).

Treatment

Initial treatment efforts were focused on mobilization of the type II non-neutral dysfunctions at T1 and T2 with muscle energy and high-velocity technique (see Chapter 9 for details). With vertebral correction noted with respect to positional and motion attributes, treatment efforts were directed at the first rib. Using MET, significant improvement in rib position and correlative cervical range of motion was noted (side-bending left, rotation right 90%). In addition, the patient reported a significant (75%) decrease in pain and hyperesthesia of the cervical musculature, as well as elimination of right upper extremity paresthesia (Fig. 10.30).

The patient was subsequently instructed in postural re-education, as well as self-stretching of the right anterior and medial scalene, sternocleidomastoid, and levator scapulae muscles.

On returning to the clinic for her second visit, the patient complained of a re-exacerbation of the right cervical and upper extremity symptoms (pain and paraesthesia) after self-stretching. Re-examination revealed maintained correction of the type II non-neutral dysfunctions at T1 and T2. However, the right, first rib was once again displaced cranially with associated myofascial dysfunction as initially noted.

Treatment in this session focused on normalization of myofascial dysfunction of the anterior and medial scalene, sternocleidomastoid, and levator scapulae muscles with respect to increased tone, diminished play, and functional excursion. Techniques

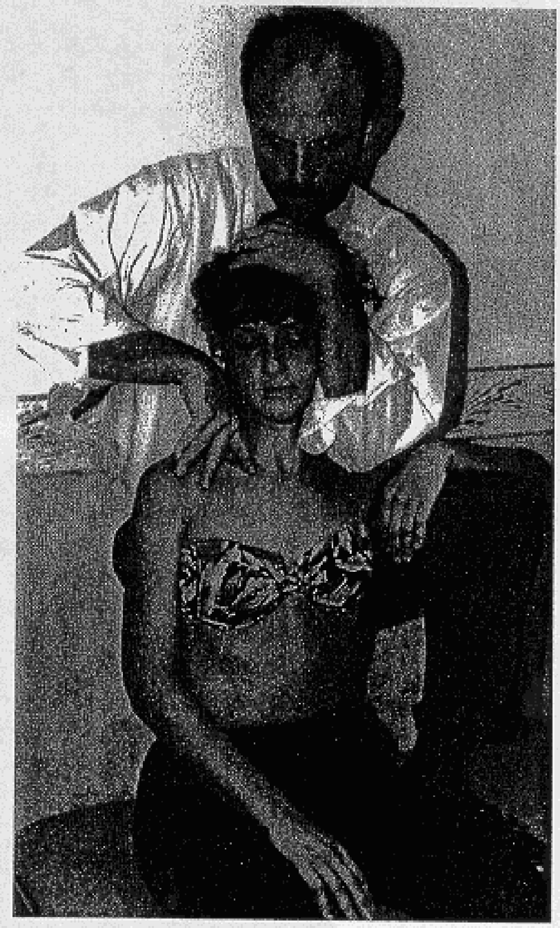

Figure 10.30. Muscle energy technique (MET) to the first rib in the seated posture to correct a superior subluxation of that rib.

used included end-range perpendicular strumming of the scalene muscles (in a shortened range), parallel technique to the sternocleidomastoid, and strumming technique to the levator scapulae (seated/lengthened position) (Figs. 10.31, 10.32, and 10.33). Muscle energy technique was then used once again with the patient in a seated position to normalize the first rib.

In addition, after the position of the first rib was restored, functional excursion of the anterior and medial scalenes was addressed with the patient in a seated position, while providing counter support and stabilization to the right first rib. This was accomplished via digital contact and through a series of hold-relax elongation techniques. The patient was then instructed in home self-stretching technique of these muscles with counter support provided

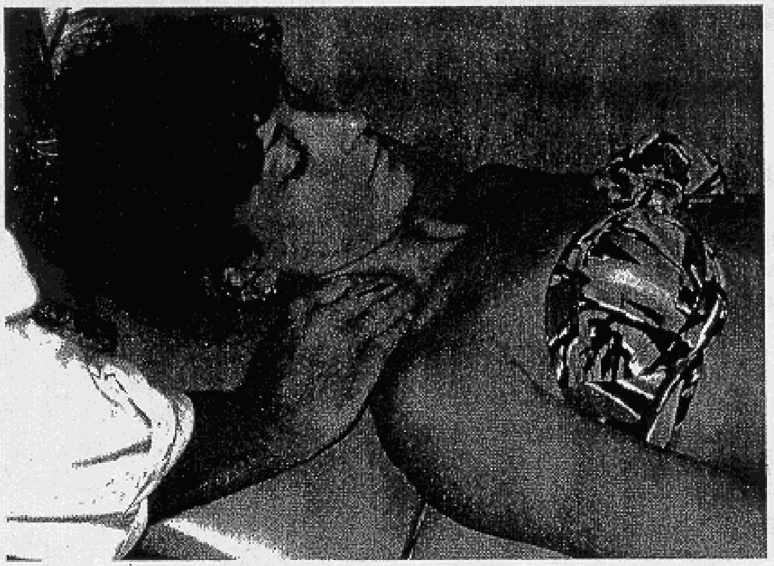

Figure 10.31. End-range perpendicular soft-tissue mobilization technique to the scalenes in a shortened position.

Figure 10.32. Parallel soft-tissue mobilization technique to the sternocleidomastoid.

through the use of a sheet, with a caudally directed force over the first rib (Figs. 10.34 and 10.35).

Treatment Progression and Analysis

Initial treatment efforts were directed at the correction of the type II non-neutral dysfunctions at the T1 and T2 vertebral levels. This strategy was used because position/motion dysfunction of these vertebral segments is commonly associated with and frequently causes dysfunction of the first rib, with resultant upper extremity brachialgic complaints. These efforts were followed by successful treatment of the first rib as noted. The patient was instructed in prescriptive stretching of the involved soft tissues (anterior and medial scalenes, sternocleidomastoid, levator scapulae) for a home program. However, on returning to the clinic the patient demonstrated recurrence of the elevated first rib on the right. This reportedly occurred when the patient was performing home stretching of the anterior and medial scalenes. Treatment was redirected toward the myofascial dysfunction of the involved soft tissues with particular emphasis on normalizing the play and

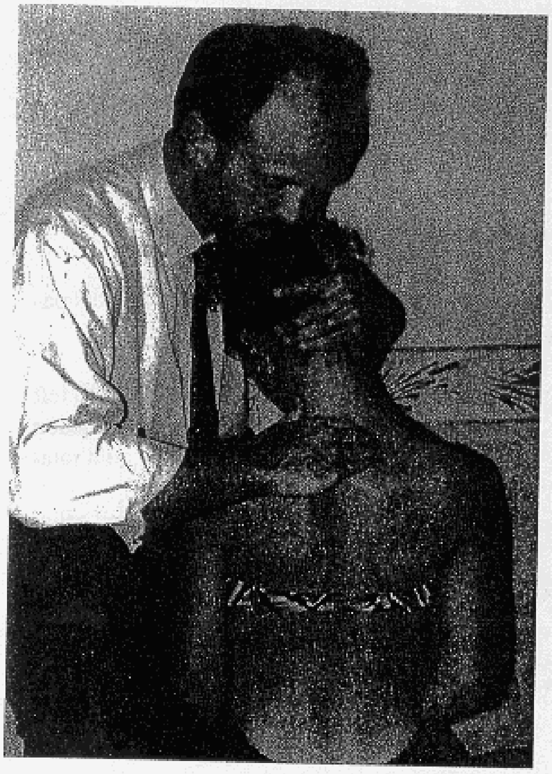

Figure 10.33. Strumming soft-tissue mobilization technique to the levator scapulae muscle.

length of the anterior and medial scalene muscles and the play of the sternocleidomastoid. In addition, the patient was instructed in self-stretching with appropriate counter support to the first rib.

This case emphasizes the importance of clearing soft-tissue dysfunction that may be implicated in the pathogenesis of vertebral and rib cage dysfunction. It also serves to illustrate how these tissues may perpetuate or cause recurrence of these dysfunctions if left untreated.

Case 2

C: Chief Complaint

A 32-year-old right-handed man was seen with complaints of localized left anterior chest wall pain, especially on full exhalation, over a 5-week period of time. He denied any neurologic symptoms including tingling, numbness, weakness, or radiating pain into either upper extremity.

H: History

This patient described a mechanical history of injuring himself while weight training. He described performing bilateral overhead flies with a 50-pound dumbbell while in a supine position and experiencing a strain of the left pectoral muscle group, which progressed over a 3-day period to include the anterior chest wall. After approximately a 3-week rest period, with treatment including ice packs and gen-

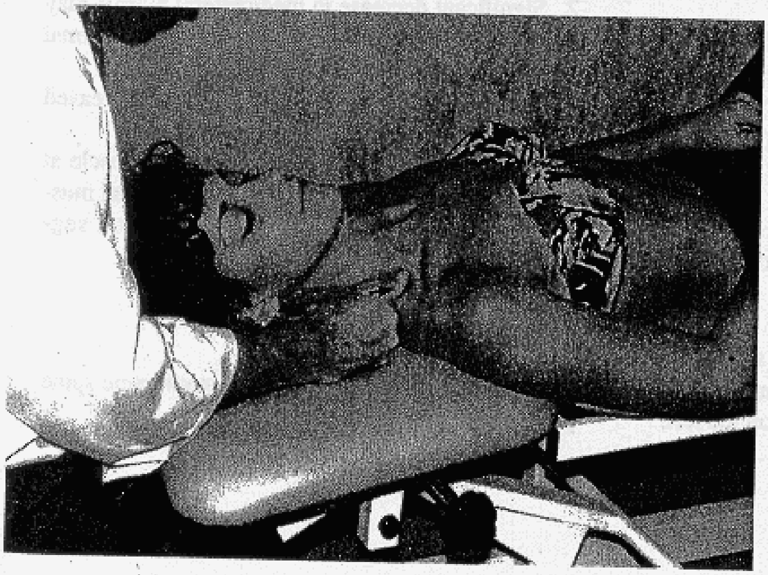

Figure 10.34. Functional excursion/elongation of the anterior and medial scalenes with counter support provided to the first rib through the thumb and second digit.

Figure 10.35. Self-stretch home program for the anterior and medial scalenes.

tle self-stretching, the patient attempted weight training once again. However, the chest wall pain increased and on examination was present with all exhalation efforts as well as overhead movements of the right upper extremity.

Other details of the history for this patient, including familial, past medical, pharmacologic, social, and occupational aspects, proved to be noncontributory.

A: Asymmetries of Bony Landmarks

The key asymmetric findings for this patient included:

1. Diminished anterior intercostal space between ribs 4 and 5 on the left with increased spacing posteriorly between ribs 4 and 5 on the left.
2. Anterior, posterior, and lateral rib contours that were unremarkable with respect to asymmetric prominence.
3. The superior margin of the fifth rib was palpable posteriorly, with a sharp border.
4. A type II non-neutral ERS left dysfunction was noted at the T4 vertebral dysfunction.
5. All other vertebral and rib segments appeared symmetric with the patient in the static seated posture.

R: ROM/Mobility Testing

Positive results of the key motion tests for this patient included:

1. Confirmation of the type II non-neutral ERS left dysfunction noted at the T4 vertebral dysfunction with diminished flexion, side-bending, and rotation to the right.
2. Aberrant respiratory motion testing on full exhalation on the left.
3. Diminished spring testing of the superior border of the left fifth anterior rib (cranial to caudal direction) with firm end-feel.
4. Diminished spring testing of the inferior border of the left fifth posterior rib (caudal to cranial direction) with firm end-feel.

T: Tissue Texture/Tension/Tonal Abnormalities

The key tissue abnormalities for this patient included:

1. Diminished caudal shear of the skin and superficial fascia in the left anterior clavipectoral region.
2. Significant decrease in mediolateral muscle play of the left pectoralis minor muscle at its proximal insertion of ribs 4 and 5.
3. Decreased functional excursion and increased tone of the left pectoralis minor muscle.
4. Increased tone of the left iliocostalis muscle at the fifth costal segment and the intercostal muscles between the fourth and fifth costal segments.

S: Special Tests

Radiologic assessment of the cervicothoracic spine produced negative findings.

Musculoskeletal Diagnosis

1. Type II non-neutral ERS left dysfunction at T4.
2. External torsion dysfunction of the left, fifth rib.
3. Exhalation respiratory dysfunction of ribs 3, 4, and 5 on the left, with rib 5 designated as the "key rib."
4. Myofascial dysfunction of the left pectoralis minor muscle (decreased muscle play, increased tone), the intercostal muscles (between costal segments 4 and 5), and the iliocostalis muscle at the fifth costal segment.

Treatment

Initial treatment efforts included MET directed at normalizing the type II non-neutral T4 ERS left dysfunction with correction noted after the first treatment session (Fig. 10.36). In addition, efforts were directed at normalizing the external torsion dysfunction of the left fifth rib with MET with the patient in both the supine and seated positions. This, however, proved resistant to treatment

During the second treatment session efforts to normalize the external torsion dysfunction with MET once again proved to be unsuccessful. Treatment efforts were redirected at the myofascial dysfunction of the superficial and deep clavipectoral fascia and the pectoralis minor and intercostal muscle groups.

The superficial fascial restrictions were ameliorated by identifying and directing treatment at the epicenter of the restrictive barrier in the fascia overlying the fifth costal segment. This was accomplished with a push technique (treating hand) and through placing the immediate surrounding tissues in a shortened range (assist hand) (Fig. 10.37).

The pectoralis minor demonstrated significant diminution in muscle play at the fourth and fifth costal segments on the left. In addition, the left pectoralis minor muscle demonstrated poor dissociation from the overlying pectoralis major muscle. These dysfunctions were treated by placing the muscle group in a shortened position and directing a perpendicular mobilization force to the respective barrier (keeping the tissue barrier level and the direction of the restriction in mind). In addition, a strum technique was used to restore muscle play while decreasing muscle tone, as well as to improve dissociation of the two muscles. A parallel technique was also used along the lateral seam of this muscle with a significant reduction in tone and moderate gains in muscle play noted. These techniques were used while progressing from a shortened to fully lengthened position (Figs. 10.38 and 10.39).

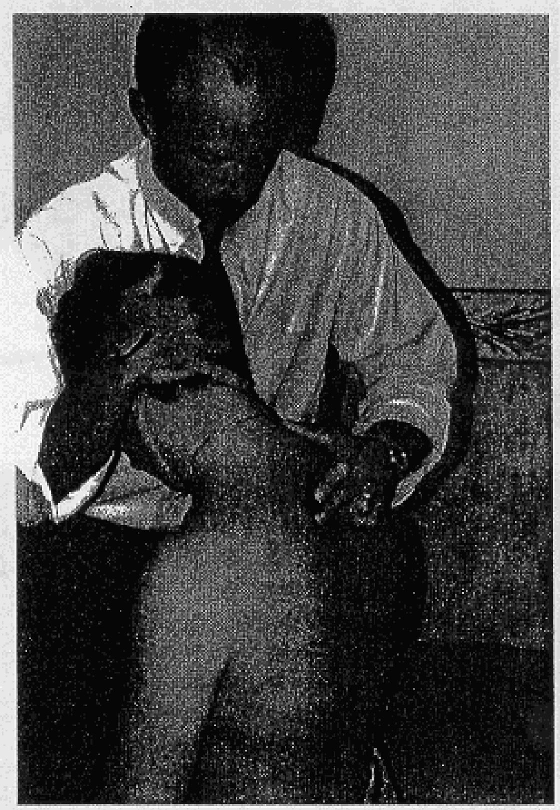

Figure 10.36. Muscle energy technique (MET) to the T4 vertebral segment in the seated position to correct a type II nonneutral ERS left dysfunction with diminished flexion, sidebending, and rotation to the right.

The intercostal muscle groups between the left fourth and fifth ribs were treated with bony contour technique with the patient in a sidelying position to lengthen or increase the intercostal spacing. This technique was performed circumferentially (Fig. 10.40).

After treatment, reassessment of the external rib torsion dysfunction demonstrated improvement of approximately 75% (both objective and subjective). MET was next used to completely normalize position and motion characteristics to the structural rib dysfunction. After this correction, the respiratory movements also proved to be normalized, with absence of the previous group exhalation dysfunction noted at ribs 3, 4, and 5.

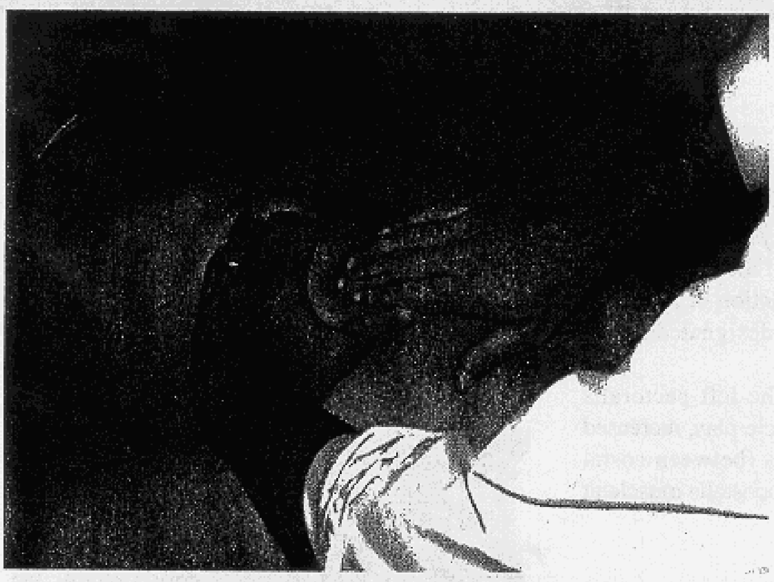

Figure 10.37. Superficial fascial soft-tissue mobilization push technique to the clavipectoral fascia over the fifth costal segment.

Figure 10.38. Strumming soft-tissue mobilization technique to the pectoralis major/minor complex with digital contact.

The treatment session was completed with the patient engaged in a posterior-elevation/anterior-depression proprioceptive neuromuscular facilitation (PNF) pattern with a combination of isotonics (placing, isometrics, concentrics, eccentrics, slow reversal hold) to provide neuromuscular re-education, improved functional excursion, and challenge the pectoralis minor muscle and its corresponding rib segments (Fig. 10.41 and 10.42).

The patient was instructed in a home program that included self-strumming and doorway stretching to the left pectoralis minor muscles, followed by diaphragmatic, diagonal breathing patterns to maintain respiratory correction.

Treatment Progression and Analysis

Initial treatment attempts were directed at correction of the ERS T4 dysfunction because this commonly causes external torsion dysfunction of the rib cage. Correction of the vertebral dysfunction will often yield concomitant correction of the rib dysfunction.

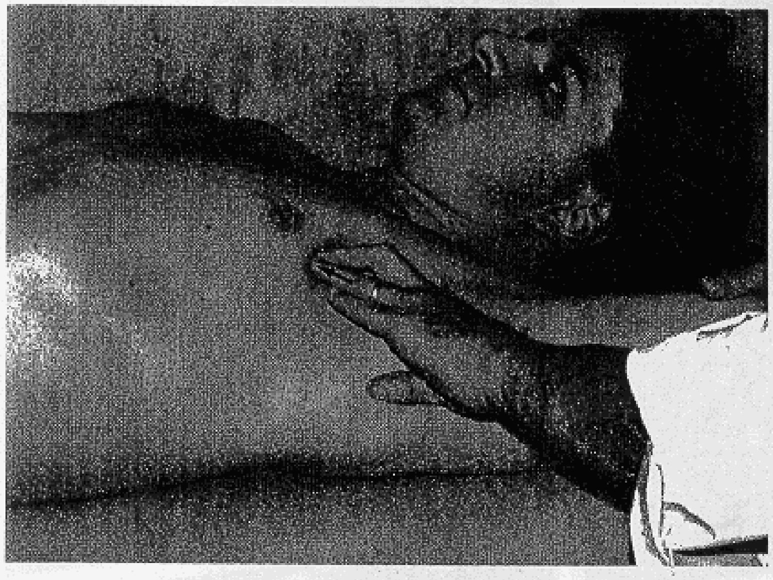

Figure 10.39. Parallel soft-tissue mobilization technique to the pectoralis major/minor complex in a lengthened position.

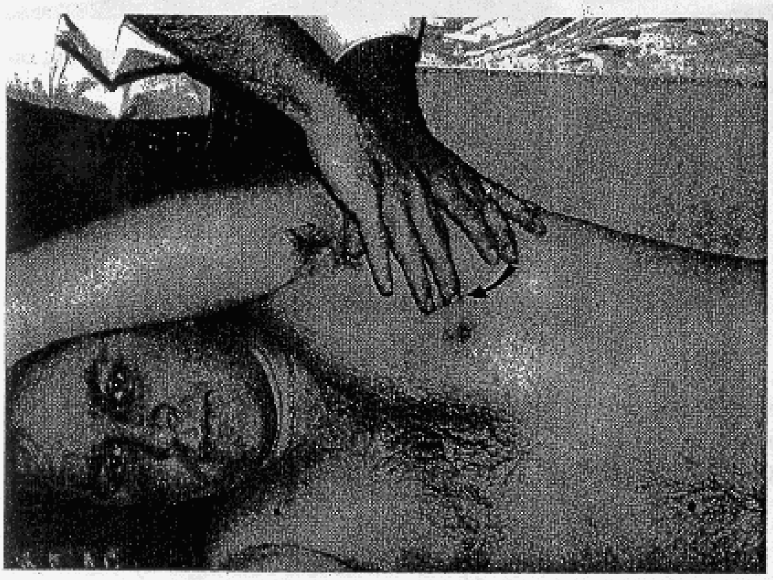

Figure 10.40. Bony contour soft-tissue mobilization technique to ribs 4 and 5. This is performed circumferentially about the entire rib cage.

This, however, is not true where chronicity and myofascial dysfunction coexist. Attempts to use MET in correcting the external rib torsion dysfunction (which was also acting as the "key rib" in the exhalation dysfunction) were unsuccessful secondary to the significant myofascial dysfunction of the pectoralis minor muscle (most notably, diminished play and increased tone). After normalization of the myofascial tissues (particularly muscle play and tone at the pectoralis minor muscle), both muscle energy and PNF techniques were carried out with success, with the external torsion dysfunction normalized and the associated exhalation dysfunction corrected simultaneously.

This case serves to demonstrate the importance of myofascial work in combination with traditional MET as both preparative and corrective. In addition, it illustrates the importance of considering all of the attributes of soft tissues (i.e., muscle play, tone, functional excursion, and neuromuscular control) in contrast to length or functional excursion only.

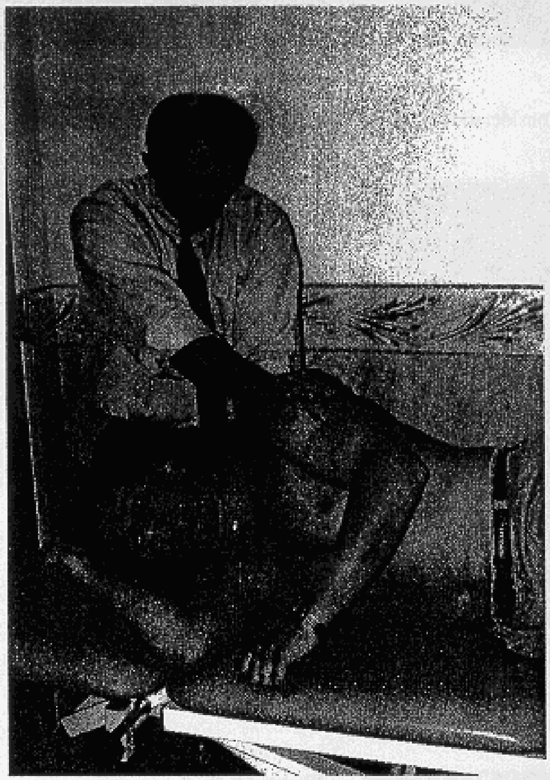

Figure 10.41. Proprioceptive neuromuscular facilitation, posterior elevation pattern to the shoulder girdle to challenge the corrected rib segment as well as improve neuromuscular control.

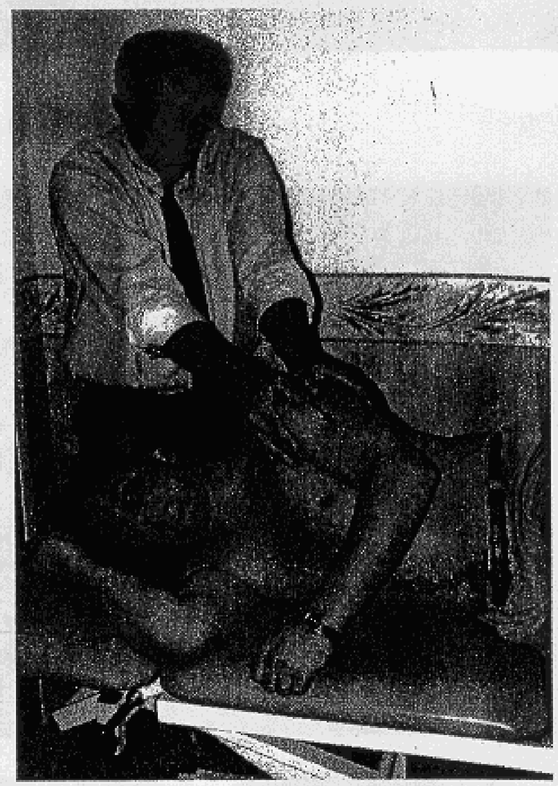

Figure 10.42. Proprioceptive neuromuscular facilitation, anterior depression pattern to the shoulder girdle.

Case 3

C: Chief Complaint

A 25-year-old female body-builder was seen with a 3-month history of thoracolumbar and right lower rib cage pain, especially with rotation to the left and on inhalation efforts.

H: History

This patient described injuring herself while attempting to lift a heavy object from a flexed position. She described a "catching sensation" in the lower thoracic spine and immediate discomfort in the right anterior lower rib cage. She also reported a similar injury in the same region approximately 2 years earlier.

Other details of the history for this patient, including familial, pharmacologic, social, and occupational aspects, were noncontributory.

A: Asymmetries of Bony Landmarks

The key asymmetric findings for this patient included:

1. A type II non-neutral FRS right dysfunction at T10.
2. A type I neutral, side-bent right, rotated left dysfunction at T11, T12, and L1.
3. Leg length discrepancy (short left approximately 6 mm) with an elevated right iliac crest, elevated right anterior superior iliac spine, elevated right posterior superior iliac spine, and elevated right greater trochanter and fibular head.

R: ROM/Mobility Testing

Positive findings on the key motion tests for this patient included:

1. Confirmation of a type II non-neutral FRS right dysfunction at T10 with diminished extension, side-bending, and rotation to the left.
2. Confirmation of a type I neutral, side-bent right, rotated left dysfunction at T11, T12, and L1 with diminished side-bending left and rotation right at T11, T12, and L1.
3. Aberrant respiratory motion testing on full inhalation of the right lower rib cage.

T: Tissue Texture/Tension/Tonal Abnormalities

The key tissue abnormalities for this patient included:

1. A significant increase in tone of the right iliopsoas muscle, the right respiratory diaphragm (along the inferior border of the anterior rib cage), and the right multifidus musculature (at the T10, T11, and T12 levels).
2. Diminished mediolateral muscle play of the right iliopsoas muscle at the L1, L2, and L3 levels.
3. Diminished mediolateral muscle play and functional excursion of the right quadratus lumborum musculature.

S: Special Tests

The results of special tests were all noncontributory or negative for this patient.

Musculoskeletal Diagnosis

1. Type II non-neutral FRS right dysfunction at T10.
2. Type I neutral, side-bent right, rotated left dysfunction at T11, T12, and L1.
3. Respiratory inhalation dysfunction of ribs 10, 11, and 12 on the right.
4. Leg length discrepancy, short on the left (approximately 6 mm).
5. Myofascial dysfunction of the right iliopsoas muscle (decreased muscle play, increased tone), right respiratory diaphragm (increased tone), right multifidus (increased tone), and right quadratus lumborum (decreased play and functional excursion).

Treatment

Because of the significance of this patient's myofascial dysfunction, initial treatment efforts were directed at the increased muscle tone identified along the inferior border of the rib cage (respiratory diaphragm) and the tone/muscle play problems of the right iliopsoas muscle complex. The respiratory diaphragm was initially treated with the patient seated (shortened position), followed by the supine position (lengthened position). Soft-tissue mobilization efforts included direct, sustained pressure administered to the respiratory diaphragm while the patient was encouraged to provide gentle inhalation and exhalation efforts. In addition, the bony contours of the costochondral arch were addressed with direct, end-range oscillatory mobilization technique directed at the specific restrictions encountered (Figs. 10.43 and 10.44).

The right iliopsoas muscle dysfunction was treated with a combination of perpendicular mobilization and strumming techniques. This was performed with the patient in a supine 90/90 posture (shortened position), which progressed to a lengthened position. This was followed by soft-tissue mobilization of the multifidus muscle through strumming and bony contour techniques directed along the groove between the spinous and transverse processes of the thoracolumbar spine with the patient in a quadruped, sitback position (lengthened position) (Figs. 10.45, 10.46, and 10.47).

After the correction of this MFD, MET was used to correct both the type II FRS right dysfunction at T10 (which was already approximately 50% improved) and the respiratory (inhalation) dysfunction. These efforts resulted in approximately 75% improvement with respect to vertebral and rib position/motion dysfunction, as well as specifically enumerated myofascial dysfunction. Three additional treatment sessions were required (with similar progression) to completely normalize vertebral and rib dysfunction.

On returning to the clinic for the fourth session, the patient demonstrated recurrence of the FRS right dysfunction at T10 and had complaints of pain at the thoracolumbar junction posteriorly. Treatment was redirected at the quadratus lumborum with a functional excursion/lengthening technique (treating hand), in a lengthened position over a bolster, while the assisting hand provided end-range associated oscillations (Fig. 10.48).

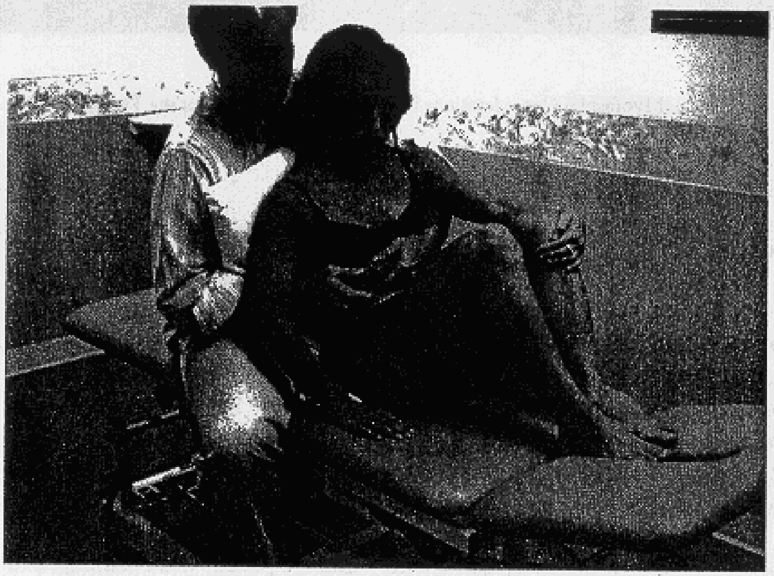

Figure 10.43. Respiratory diaphragm, bony contour, soft-tissue mobilization technique performed in a seated, shortened position.

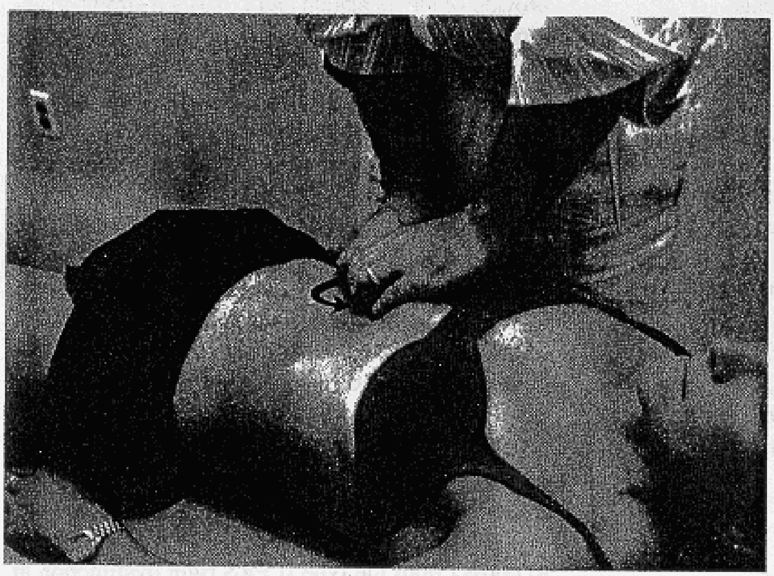

Figure 10.44. Respiratory diaphragm, bony contour, soft-tissue mobilization technique performed in a supine, lengthened position.

Once again, MET was used to correct the type II FRS right dysfunction at T10, followed by proprioceptive neuromuscular facilitation (PNF) for re-education with anterior elevation/posterior depression patterns through the pelvis (Figs. 10.49 and 10.50).

This treatment was followed by the introduction of a 6-mm heel lift to the short lower extremity to level the sacral base. No further complaints were offered and the patient was discharged.

Treatment Progression and Analysis

Treatment efforts initially directed at the myofascial dysfunction of the iliopsoas muscle and respiratory diaphragm allowed substantial progress to be realized in the normalization of the type II FRS and respiratory rib cage dysfunctions. This, however, was only temporary, and recurrence of these movement dysfunctions appeared related to the remaining my-

Figure 10.45. Muscle play/tone, soft-tissue mobilization technique to the iliopsoas muscle complex in a supine, shortened position.

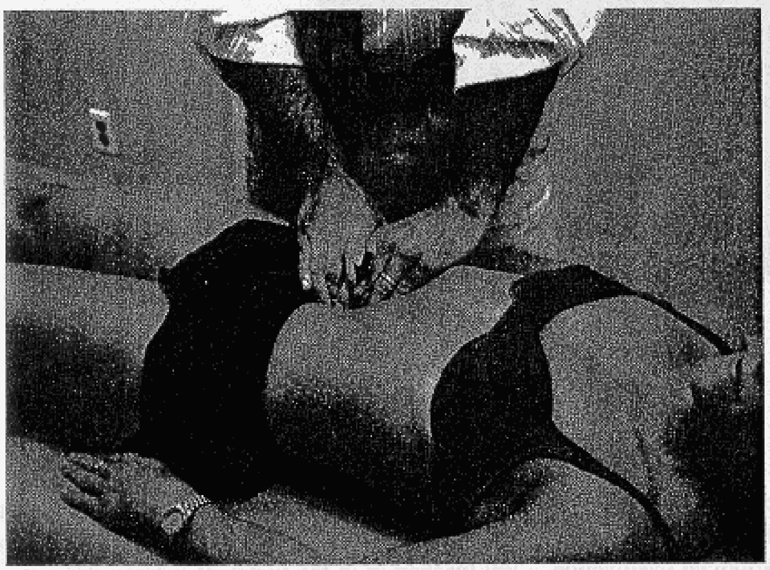

Figure 10.46. Muscle play/tone, soft-tissue mobilization technique to the iliopsoas muscle complex in a supine, lengthened position.

ofascial dysfunction and leg length discrepancy. Asymmetric muscle length and aberrant tone of the quadratus lumborum (secondary to the long right leg) provided an environment for non-neutral mechanics to exist in the thoracolumbar spine and apparently contributed to the recurrence of the type II dysfunction.

Treatment was redirected toward the quadratus lumborum and the correction of the leg length discrepancy. This provided an environment for the correction of the type II FRS dysfunction, accomplished through MET, to be maintained. Although type II non-neutral FRS and ERS dysfunctions are not typically recognized as being compensatory to a type I neutral dysfunction (in this case, secondary to a leg length), they are commonly seen as nonresponsive or recurrent in the presence of this static postural alteration. In addition, where chronicity prevails, related myofascial

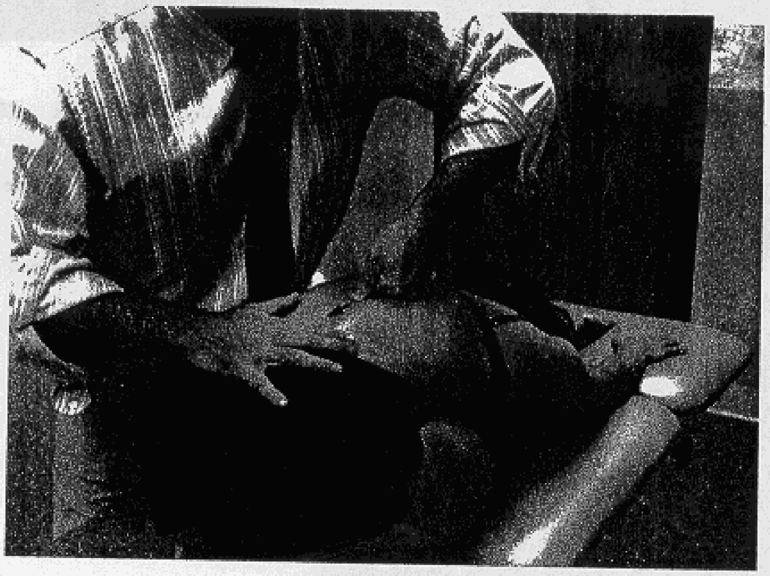

Figure 10.47. Bony contour, soft-tissue mobilization technique to the thoracic spine, paravertebral muscles and myofascial tissues in a quadruped (all fours), sit-back position.

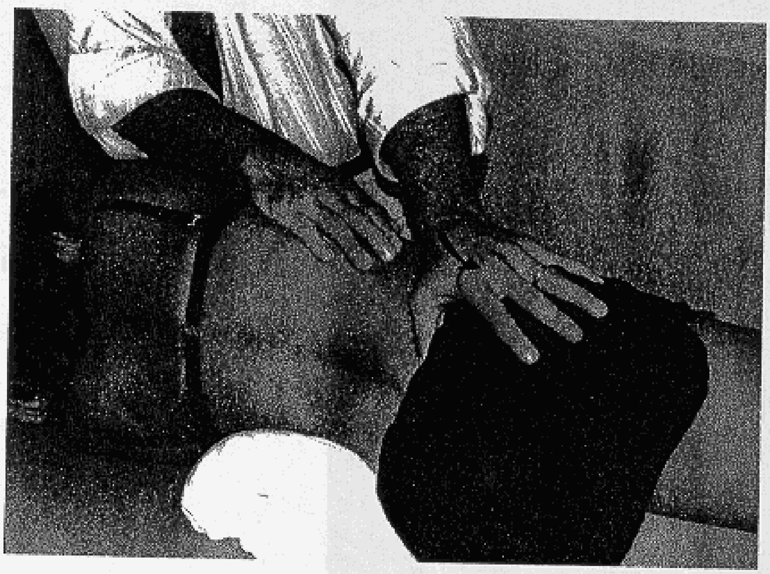

Figure 10.48. Functional excursion/lengthening technique to the quadratus lumborum with the assisting hand providing associated oscillations.

dysfunction makes correction of these articular dysfunctions more recalcitrant to treatment efforts.

This case illustrates how myofascial dysfunction accompanying static postural dysfunction (in this case, leg length dysfunction) may provide biomechanical alterations that make correction of the primary somatic dysfunction difficult, if not impossible. It also emphasizes the importance of achieving neutral mechanics in the vertebral column through the normalization of both myofascial and skeletal structures in efforts to avoid recurrence of thoracic and rib cage dysfunction.

Figure 10.49. Proprioceptive neuromuscular facilitation, anterior elevation pattern to the pelvic girdle.

Figure 10.50. Proprioceptive neuromuscular facilitation, posterior depression pattern to the pelvic girdle.

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