# Chapter 5
# Client Examination for Massage

This chapter reviews selected issues for therapists to consider when conducting a client examination prior to using massage techniques. These topics include the focus of an examination for the use of massage techniques, body structures and functions that are relevant to massage, client reports that arise during the course of history taking that can suggest soft tissue dysfunction, and the use of palpation and nonpalpatory examination techniques. Therapists can integrate this information into a client examination that is appropriate for their scope of practice and their clients' conditions. Numerous clinical texts document client examination techniques for musculoskeletal, neurological, cardiopulmonary, and psychological conditions for the various health care professions. Consequently, this chapter assumes that readers will consult those texts for details on the client examination approach and techniques that are within their scope of practice.

## Client Examination for Massage: Foundations

### FOCUS OF THE CLIENT EXAMINATION FOR MASSAGE

Chapter 3, Clinical Decision Making for Massage, outlined the purpose and steps in the Evaluative Phase of clinical decision making. Conducting a client examination for the use of massage techniques requires more than the addition of a few soft tissue examination techniques to one's customary approach to examination. To be effective, therapists need to expand the focus of their examinations to include the following objectives:

1. Treatment of Impairments Resulting from Medical Conditions
   - Identification of soft tissue dysfunction related to the client's clinical condition

- Identification of other primary and secondary impairments that therapists can treat with massage techniques
- Identification of the limitations in the client's level of activity that are associated with the impairments identified in the previous two bulleted items

2. Wellness Interventions
   - Identification of the body structures and functions in the client's wellness goals that therapists can treat with massage techniques

The assessment of soft tissue function and dysfunction can involve the use of tests and measures, such as palpation, that directly assess soft tissue.[1–38] In addition, therapists can extend their interpretation of the findings from standard musculoskeletal, neurological, cardiopulmonary, or psychological measures to include an analysis of how soft tissue dysfunction may be contributing to the client's symptoms. The extent to which therapists will have to modify their customary approach to the client examination will depend on how relevant soft tissue dysfunction is to the client's medical condition. For example, a strong focus on soft tissue dysfunction is less appropriate for the client with a longstanding below-knee amputation and a referral for gait training. By contrast, this focus would be more relevant if the client presents with chronic neck and shoulder pain. Nevertheless, therapists are wise to consider, even briefly, the role of soft tissue dysfunction and potential uses of massage techniques during their client examinations.

## RELEVANT CLINICAL OUTCOMES FOR MASSAGE

In the International Classification of Functioning, Disability and Health model (see Chapter 1), medical conditions result in impairments in body structures and functions.[1,2] These impairments are, in turn, associated with limitations in the client's ability to perform activities. During the client examination, therapists identify and measure the client's impairments. At this point, not all of the impairments will be amenable to treatment with massage techniques. In addition, failure to identify impairments may compromise the effectiveness of the treatment. The task of sorting impairments into those that are or are not amenable to treatment with massage techniques comes later in the treatment planning process. Nevertheless, it is useful to consider whether a reported or observed impairment may involve soft tissue dysfunction. Table 5-1 summarizes some of the impairments that are relevant to the use of massage techniques and gives examples of relevant examination techniques. This chapter discusses the assessment of impairments and functional limitations in preparation for using massage techniques.

**Table 5-1** Examples of Outcomes and Examination Techniques for Massage[1–376]

| Impairment | Outcome | Tests and Measures |
|---|---|---|
| **Musculoskeletal** | | |
| ■ Adhesions/scarring | ■ Increased tissue mobility<br>■ Decreased scarring | ■ Visual inspection<br>■ Measurement of dimensions<br>■ Palpation<br>■ Ultrasonography<br>■ Magnetic resonance imaging<br>■ Arthroscopy |
| ■ Impaired connective tissue integrity:<br>■ Fascial restrictions<br>■ Abnormal connective tissue density<br>■ Decreased mobility of skin, superficial and deep fascia | ■ Separation and lengthening of fascia<br>■ Promotion of dense connective tissue remodeling<br>■ Increased connective tissue mobility | ■ Visual inspection of static and dynamic postural alignment<br>■ Palpation<br>■ Skin mobility |

(*continued*)

## Table 5-1 continued

| Impairment | Outcome | Tests and Measures |
|---|---|---|
| ■ Impaired joint integrity:<br>■ Inflammation of joint capsule or ligaments<br>■ Restrictions of joint capsule and ligaments | ■ Decreased signs of inflammation of joint capsule, tendons, or ligaments<br>■ Decreased capsular and ligament restrictions<br>■ Increased joint mobility<br>■ Increased joint integrity | ■ Palpation<br>■ Selective tissue tension testing<br>■ Ligament stability tests<br>■ Magnetic resonance imaging<br>■ Arthroscopic examination<br>■ Arthrography<br>■ Stress radiography<br>■ Ultrasonography<br>(See measures of impaired joint mobility) |
| ■ Impaired joint mobility:<br>■ Decreased voluntary range of motion | ■ Increased joint mobility<br>■ Increased voluntary range of motion | ■ Universal goniometer<br>■ Parallelogram goniometer<br>■ Visual estimation of range of motion<br>■ Fingers-to-floor distance<br>■ Schoeber (tape measure) method<br>■ Passive accessory motion testing<br>■ Palpation of end feel on overpressure<br>■ Two-dimensional and three-dimensional computer-aided motion analysis<br>■ Computerized six–degree of freedom electromagnetic tracker<br>■ Self-report range of motion measures<br>■ Cervical range of motion (CROM) instrument<br>■ Single and double inclinometer<br>■ Electrogoniometers<br>■ Pelvic Palpation Meter<br>■ Arthrometer |
| ■ Impaired muscle integrity:<br>■ Decreased muscle extensibility<br>■ Muscle strains and tears<br>■ Tendinopathies<br>■ Trigger points | ■ Increased muscle extensibility<br>■ Decreased signs of inflammation and promotion of healing of tendons<br>■ Decreased signs of inflammation and promotion of healing of muscle<br>■ Decreased trigger point activity<br>■ Increased joint mobility | ■ Muscle extensibility tests<br>■ Selective tissue tension testing<br>■ Palpation<br>■ Trigger point tests: twitch response, presence of taut bands, patterns of pain referral, electromyography<br>■ Pressure sensitivity testing (pressure algometer)<br>■ Universal goniometer<br>■ Isokinetic dynamometer<br>■ Dynamic ultrasonography |
| ■ Impaired muscle performance (strength, power, endurance) | ■ Enhanced muscle performance secondary to the enhancement of muscle extensibility, reduction of pain, reduction of muscle spasm, enhancement of joint mobility, normalization of joint integrity, reduction of trigger point activity, etc.<br>■ Balance of agonist/antagonist muscle function | ■ Manual muscle testing<br>■ Hand-held dynamometer<br>■ Repeated isotonic motion<br>■ 1-repetition maximum test<br>■ Single-leg hop test<br>■ Myotome testing<br>■ Modified sphygmomanometer<br>■ Pinch meter<br>■ Self-report measures of perceived exertion<br>■ Isokinetic dynamometer<br>■ Isoinertial devices<br>■ Pedaling devices<br>■ Electromyogram<br>■ Kinematic and kinetic gait analysis with two- or three-dimensional computer assisted motion analysis and force analysis |

(*continued*)

## Table 5-1 continued

| Impairment | Outcome | Tests and Measures |
|---|---|---|
| ■ Abnormal muscle resting tension<br>■ Muscle spasm | ■ Decreased muscle spasm<br>■ Normalized muscle resting tension<br>■ Increased joint mobility | ■ Palpation<br>■ Tissue compliance meter<br>■ Continuous electromyogram<br>■ Thermography |
| ■ Postural malalignment | ■ Normalized postural alignment<br>■ Increased postural awareness | ■ Visual inspection of static and dynamic posture<br>■ Postural grid<br>■ Posture Analysis forms<br>■ Universal goniometer<br>■ Plumb line<br>■ Inclinometer<br>■ Tape measure<br>■ Photography<br>■ Kyphometer<br>■ Flexible ruler<br>■ Video image and frame analysis<br>■ Two- or three-dimensional computer-assisted motion analysis<br>■ Three-dimensional electrogoniometers<br>■ X-ray line drawing analysis<br>■ Force platforms<br>■ Functional postural analysis measures |
| ■ Impaired sensation (secondary to entrapment neuropathy or nerve root compression) | ■ Normalized sensation (secondary to the reduction of nerve and nerve root compression due to fascial restrictions and trigger points) | ■ Sensory discrimination (kinesthesia, graphesthesia, stereognosis)<br>■ Vibrometer<br>■ Dermatome testing: light touch, pin prick, temperature<br>■ Filament testing (pressure)<br>■ Palpation of nerve<br>■ Neural tension testing<br>■ Myotome testing<br>■ Electrophysiological (nerve conduction) testing<br>■ Electroneurotomy<br>■ Single-frequency vibrometry tests<br>■ Magnetic resonance imaging |
| ■ Swelling: edema, joint effusion, lymphedema | ■ Increased lymphatic return<br>■ Increased venous return<br>■ Decreased joint effusion<br>■ Decreased edema<br>■ Increased joint integrity<br>■ Increased joint mobility | ■ Visual inspection<br>■ Volumetric analysis<br>■ Girth measurements: tape measure, wire, jeweler's ring<br>■ Palpation<br>■ Multiple-frequency bioelectrical impedance analysis<br>■ Magnetic resonance imaging<br>■ Laser-Doppler flowmetry |
| **Psychoneuroimmunological** | | |
| ■ Stress | ■ Systemic sedation<br>■ Increased perceived relaxation<br>■ Decreased levels of cortisol, epinephrine, and norepinephrine | ■ Interview regarding perceived stress levels and symptoms of stress<br>■ Self-report stress measures<br>■ Galvanic skin response<br>■ Heart rate<br>■ Blood pressure<br>■ Finger pressure<br>■ Blood work: lipid peroxide, prolactin, cortisol, testosterone, glycated hemoglobin<br>■ Salivary cortisol levels |

(*continued*)

## Table 5-1 continued

| Impairment | Outcome | Tests and Measures |
|---|---|---|
| **Multisystem** | | |
| ■ Pain | ■ Pain reduction through primary treatment of dysfunction, e.g., active trigger points<br>■ Counterirritant analgesia<br>■ Systemic sedation resulting in decreased perception of pain | **Pain Behavior**<br>■ Interview regarding location, quality, and behavior of pain<br>■ Pain diagram (used in conjunction with interview)<br>■ Self-report measures of pain intensity and affective component<br>■ Self-report measures of the impact of pain on function<br>■ Palpation<br>■ Pressure sensitivity testing (pressure algometer)<br>■ Selective tissue tension testing<br><br>**Tests and Measures of Pain Syndromes**<br>■ Neural tissue tension tests<br>■ Neural provocation tests<br>■ Trigger point tests: twitch response, presence of taut bands, patterns of pain referral, electromyography<br>■ Dynamic surface electromyography<br>■ Electrophysiological studies<br>■ Thermography |
| **Cardiopulmonary** | | |
| ■ Impaired airway | ■ Increased respiration/gaseous exchange<br>■ Increased airway clearance/mobilization of secretions<br>■ Decreased dyspnea | ■ Interview regarding frequency and effectiveness of cough<br>■ Visual inspection of effectiveness of cough<br>■ Visual inspection of quality and quantity of sputum<br>■ Visual inspection and palpation of respiration rate and pattern<br>■ Auscultation of breath sounds<br>■ Pulse oximetry<br>■ Self-report dyspnea rating scales<br>■ Arterial blood gases<br>■ Pulmonary function tests<br>■ Self-report measures of quality of life<br>■ Standardized measures of self-care |
| ■ Dyspnea | ■ Decreased dyspnea due to increased airway clearance<br>■ Decreased dyspnea due to increased perceived relaxation | ■ Visual inspection of respiratory pattern and effort of breathing<br>■ Self-report perceived exertion and dyspnea rating scales<br>■ Self-report measures of outcome of dyspnea<br>■ 6-minute walk test of functional exercise capacity<br>■ Respiration rate<br>■ Oxygen saturation<br>■ Arterial blood gases<br>■ Capnography |
| ■ Impaired rib cage mobility (other than bony abnormality) | ■ Increased rib cage mobility<br>■ Increased muscle extensibility<br>■ Increased ventilation | ■ Visual inspection and palpation of lateral costal, sternal, and diaphragmatic motion during respiration<br>■ Palpation of rib cage motion during respiration<br>■ Changes in girth of rib cage during respiration |
| **Neurological** | | |
| ■ Abnormal neuromuscular tone: spasticity, rigidity, clonus | ■ Normalized neuromuscular tone<br>■ Alteration of movement responses through proprioceptive and exteroceptive stimulation techniques<br>■ Balance of agonist/antagonist muscle function | ■ Palpation<br>■ Graded passive range of motion tests, e.g., Ashworth scale<br>■ Quick stretch tests<br>■ Reflexes<br>■ Pendulum test<br>■ Isokinetic dynamometer<br>■ Hand-held dynamometer<br>■ Electromyogram with isokinetic dynamometer<br>■ Electrophysiological testing<br>■ Standardized measures of motor control<br>■ Standardized measures of self-care |

The Wellness Interactions Model guides therapists' examinations of clients who request wellness interventions (see Chapter 1). First, therapists will determine clients' perceived level of wellness and how this relates to their health status. Often, clients who have no medical condition and state that they seek only wellness or relaxation, will present with significant impairments such as anxiety, increased muscle resting tension, postural shortening, muscle weakness, limited range of motion, and pain. If this is the case, therapists may have to explain how these impairments can affect a client's well-being. In this situation, the assessment of impairments and limitations in activity performance may still be relevant. Technically, in a true wellness client, impairments are at a grade zero. When this occurs, therapists still assesses body structures and functions to determine which are amenable to optimized function or to determine when prevention of a potential impairment may be a desired outcome. Furthermore, this examination must also identify the client's current wellness behaviors and any barriers and facilitators to wellness such as social attitudes, available wellness services, education, and the individual's financial status.

## ISSUES IN THE CLIENT HISTORY FOR MASSAGE

Numerous clinical texts detail the nuances of history taking for the various health care professions. During the course of taking the standard client history, therapists can integrate questions to identify **soft tissue dysfunction**. Box 5-1 contains a brief list of issues that may prompt further exploration of a soft tissue lesion.

### Box 5-1 Issues in a Client History That Suggest Soft Tissue Dysfunction

- Reports of any longstanding musculoskeletal condition because this may result in chronic soft tissue tightening[4,6,7,9,23–36]
- A history of prolonged infection
- Reports of a change in pain over time from an initially specific, localized pain to a more diffuse, generalized pain
- A history of chronic pain
- A history of pain combined with anxiety or stress
- Idiopathic pain with a complex history of multiple injuries or multiple surgeries because these events that would predispose the client to scarring
- A history of ambiguous symptoms, particularly when motion testing yields inconclusive results and subjective reports of symptoms are vague or ambiguous
- A history of multiple conflicting assessments or multiple ineffective treatments
- A history of a gradual onset of symptoms with a clearly perceived alteration of posture over approximately the same time period
- A history of having a relief of symptoms through massage or stretching
- The reported prior treatments do not include comprehensive treatment of soft tissue lesions; for example, treatment with ultrasound but not frictions for tendinitis
- During history taking, the client refers to the texture of her soft tissue as "tight," "hard," or "wired" and makes a connection between this texture and her symptoms
- A history of bony malalignment such as a leg length discrepancy, scoliosis, or dental malocclusion
- A history of emotional trauma

### Critical Thinking Question

What specific modifications do therapists need to make to their approach to client examination so that their examination findings will guide their use of massage techniques?

## USING PALPATION IN THE CLIENT EXAMINATION

Skilled **palpation** is an art, a required component of many client examination techniques, and a prerequisite skill for the effective execution of all massage techniques.[3–38] Therapists can use palpation to assess and reassess the client's impairments throughout the client examination and treatment process. Furthermore, continuous palpation throughout the application of massage techniques allows therapists to use the client's response to the techniques to guide them in refining the intervention as it proceeds. This is one of the advantages of massage techniques over nonmanual treatment techniques.

There are many ways to perform palpation that are determined by the purpose of palpation, the object of palpation, the client's condition, and the therapist's abilities.[3–38] Regardless of how therapists are performing the palpation, all forms of palpation share common characteristics. During palpation, therapists attempt to identify subtle characteristics of the selected object of palpation and distinguish between normal and abnormal findings. Since palpation is comparative in nature, it involves movement of the contact

surface or of therapists' attention. Although the emphasis of this chapter is on the client examination, the comments on palpation are also relevant to the treatment process.

## Basic Principles of Palpation

Palpation is moving inquiry that requires an unhurried, nonabrupt manner and a quiet, listening mind.[3–38] As therapists perform palpation, they seek answers to a variety of questions that inform effective palpation such as: What is this structure or quality? How does this finding differ from other structures or qualities that I have palpated? How does this finding relate to the client's history? How does this structure reflect the client's demonstrated and reported function? After extensive practice, therapists can move from the point at which conscious questioning guides their palpation to a point at which they are more adept at the practice of Intelligent Touch (see Chapter 1).

## Objects of Palpation

Therapists identify the client's impairments through the palpation of specific **objects of palpation**.[3–38] These objects of palpation are the focus of therapists' attention during palpation. They are not necessarily physical objects; instead, they may be a characteristic, such as temperature, or a phenomenon, such as resistance to movement. The nature of the object of palpation influences therapists' choice of method of palpation. For example, it is difficult to palpate skin temperature using deep thumb pressure. In the same way, it is less effective to palpate tissue resistance to barriers in the superficial fascia using a fast scanning palmar contact. Consequently, therapists should specify the object(s) of their inquiry prior to beginning palpation and select a palpation technique that is suited to the object of palpation.

## Contact Surfaces Used for Palpation

Therapists' hands must be supple and relaxed at all times during palpation.[3–38] Since therapists' dominant hands are generally more sensitive, they should use that hand for palpating very subtle objects. As they perform palpation, they may use their hands to do similar things such as comparing left and right sides. Conversely, their hands may perform different tasks, as is the case when one hand moves a body segment and the other evaluates the resulting motion.

Therapists can use virtually any surface to palpate: fingers and thumbs, the whole palmar surface, the thenar and hypothenar eminences, or the back of their hands.[3–38] They should select a surface that relates to the particular aim of palpation. For example, the finger and thumb tips and pads have the greatest discriminatory ability and are best for palpating subtle objects. On the other hand, grasping forms of palpation may use the index and thumb together like a pincer or the whole hand.

## Force of Palpation

As with massage techniques, therapists should match the force they apply to the tissues during palpation to the task at hand.[3–38] This force can vary in rate, pressure, direction, and duration.

### *Rate of Palpation*

Therapists can use different rates of palpation to obtain different types of information.[3–38] A scanning or stroking type of palpation moves relatively quickly over a large area. Consequently, therapists use this when they want to collect information from a wide area. An example of this would be comparing bilateral tissue contours or assessing resting muscular tone of the client's entire back. A **scanning, or stroking, palpation** works best when static palpation would distort findings. By contrast, **static palpation** involves no movement of the palpating hand and is best suited for palpating moving phenomena such as pulse or respiratory rhythm.

### *Pressure of Palpation*

Lack of concentration, too much pressure, and too much movement are among the other common errors of palpation. Therapists should use the minimum pressure required to contact the chosen tissue or structure.[3–38] In doing so, they proceed from exerting a lighter force to a greater force, which results in the palpation of superficial tissue layers prior to deeper layers. Therapists do not need to apply pressure slowly. Nevertheless, therapists' touch should be firm, not tentative or abrupt, regardless of the rate at which they are applying pressure. There will be occasions when therapists need to apply a considerable amount of compression to the client's tissues. In these situations, therapists need to gauge how the clients' compressed tissues are deforming under the controlled application of their body weight. This type of palpation might be better termed "proprioceptive" palpation, as opposed to "manual" palpation, because therapists use their entire body to sense the movement of tissues.

### *Direction of Palpation*

Therapists can apply the **force of palpation** as a **shearing** force perpendicular to or parallel to the client's tissues.[3–38] Different directions of force will result in different responses of the client's tissues.

When the force of palpation is perpendicular to the client's tissues, it will produce a vertical compression. This form of palpation has several uses. For example, therapists can use perpendicular forces to palpate a pulse or pitting edema. They can also use them when measuring the sensitivity of a trigger point.

Tension along a tissue layer and **drag** occur when therapists apply the force of palpation in a direction that is parallel to the client's tissues (horizontal force).[3–38] Drag is a term used to describe both the therapist's palpation and the tissue layer's resistance to lengthening in response to that force. External and internal factors can result in an increase or decrease of the amount of drag that occurs during palpation. External factors include the presence of moisture on the skin, which can increase or decrease drag, and the presence of skin oil or lubricant, which can generally decrease it. Internal factors include tissue dystrophy. The assessment of drag is an integral part of therapists' examination of connective tissues such as skin and fascia.

Therapists can also use palpation to exert a shearing force on the client's tissues.[3–38] Shear involves adjacent, parallel tissue layers sliding over one another and displacing adjacent laminar elements. When drag is applied to a specific tissue layer, shear occurs between that layer and the layer that is adjacent and parallel to it. Therapists can use shearing forces, in combination with compression, when assessing muscle tone and bulk.

In practice, any palpation technique or massage technique combines elements of compression, drag, and shear.[3–38] In general, the direction of the force that therapists apply during the palpation of a particular tissue is often the same as the direction that they would use to treat that tissue.

### *Duration of Palpation*

Although therapists should not hurry palpation, their palpation of most objects need not take longer than a few seconds.[3–38] Indeed, the effects of prolonged palpation on tissues can confound the client examination. This occurs because maintaining a position or pressure can result in the adaptation of tissue receptors in the therapists' hands. In addition, it can also produce changes in the client's tissues. For example, when palpating a myofascial trigger point located in a deep layer, sustained pressure would have the same effect as the specific compression technique used for treatment of this condition. The palpation of barriers in connective tissue is an exception to this rule because it requires longer than a minute as a result of the biochemical nature of the tissue. In this situation, palpation will merge into treatment.

## Integration of Information from Other Senses

Effective palpation is the result of appropriate interplay of therapists' senses.[3–38] For example, therapists' vision may be useful in corroborating some of the findings of palpation such as posttraumatic swelling. Visual inspection may, however, interfere with therapists' ability to palpate more subtle objects such as the small intrinsic movements of connective tissue under traction.

## Assessing Objects of Palpation

Therapists need to match palpation techniques to the object of palpation. The following are examples of objects of palpation and appropriate palpation techniques.

### *Temperature*

The palpation of temperature can provide information about the status of inflammation, circulation, and organ function.[3–38] There are several approaches to palpating temperature. In one method, therapists place the back of their hands in direct contact with the client's skin. The pressure used for this method must be very light; otherwise, vasodilatation will occur and confound the findings. Another method is to use the palm of the dominant hand to scan approximately 4 inches (10 cm) off the surface of the client's body. In this technique, the motion of the therapist's hands must be continuous to avoid vasodilatation, insulation, and reradiation effects.

### *Contour and Bulk*

Contour and bulk refer to the gross shape and size of the client's body. Therapists can best examine these characteristics with a relatively fast-moving scanning palpation using a large contact surface such as the entire palmar surface of their hand.[3–38] Therapists should correlate the information they obtain from their palpation of contour and bulk with the findings from their visual inspection of the client's body.

## *Texture and Consistency*

Texture and consistency refer to variations in the density of tissues, regardless of the depth of the layer in which the tissues occur.[3–38] In other words, they describe the density of superficial tissues, such as the skin, or deeper tissues, such as the hamstring attachment to the ischial tuberosity.

There are two categories of tissue texture that are important because they reflect the presence of inflammation.[3–38] The first is acute inflammation, which generally produces different degrees of tissue softness that reflect the presence of extravasated fluid in the tissues. The terms "distended," "spongy," or "boggy" describe this texture. The second is chronic inflammation, which typically produces varying degrees of tissue "hardness" as a result of the deposit of collagen into the tissues. Some descriptors for the tissue "hardness" associated with chronic inflammation are "indurated," "ropy," and "stringy."

## *Fluid Status*

Therapists can use palpation to measure turgidity, which is fluid pressure or fluid tension.[3–38] Fluid tests, such as the ballottement test, involve the use of large contact surfaces to palpate excess fluid and push it from one place to another. These tests enable therapists to gauge the amount of excess fluid in an area and the pressure of the fluid. They can also assess whether the fluid is located in the intra- or extra-articular space, that is, whether it is an edema or an effusion. Finally, therapists can use sustained digital compression to determine whether "pitting" is present.

Viscosity refers to the "thickness" or "stickiness" of semi-liquid materials.[3–38] Therapists can assess viscosity using palpation. This is valuable because muscle and connective tissue commonly become less viscous in response to interventions such as the local application of neuromuscular or connective tissue massage techniques or heat.

## *Palpating Soft Tissue Layers ("Layer Palpation")*

Traditionally, the term **soft tissue** describes any tissue that is not bone or articular surface.[9,16,25,26] More specifically, soft tissue includes the **epithelium**, the **connective tissues**, and the **contractile tissues**. Therapists frequently encounter a succession of layers of tissue that are oriented from surface to deep as they palpate clients' bodies. In doing so, they can use differences between the characteristics of these layers, such as hardness, density, texture, and mobility, to distinguish between tissue layers.

There are several distinct tissue layers.[9,16,25,26] The epithelium consists of closely packed columnar or squamous cells that have little intercellular material between them. Connective tissue consists of several different types of cells, such as fibroblasts and fat cells, and elastin and collagen fibers embedded in a matrix of gelatinous material, the consistency of which varies in response to many factors. Nerves, blood vessels, and lymph vessels lie in the connective tissue. Contractile tissue is comprised of muscle, its enveloping fascial layers, its associated tendon(s), and its periosteal attachments.

As Figure 5-1 shows, the skin consists of a layer of epithelium, the epidermis, and the dermis, which is the first layer of connective tissue.[9,16,25,26] Deep to the skin lies the **superficial fascia**, which houses fat and water, provides a path for nerves and vessels, and sometimes contains striated muscle that controls the movement of the skin. The investing layer of the **deep fascia** is dense connective tissue that lies between the superficial fascia and muscle. The investing layer of the deep fascia is continuous with the superficial fascia and the deep fascia that lie between muscle fibers. The primary functions of the deep fascia are to allow muscles to move freely, to carry nerve and blood vessels, to fill the space between muscles, and to provide an origin for muscles. For example, aponeuroses, retinacula, and interosseous membranes are all deep fascia. The deep fascia around muscle is continuous with the periosteum. In areas in which there is no muscle, the investing layer of the deep fascia is continuous with the periosteum. Finally, connective tissue exists in synovial joints; for example, the synovial membrane and the extrinsic ligaments are modified connective tissue.

### Skin

Therapists should use minimal force and note the following characteristics as they palpate clients' skin.[4,8,9,16,24–26] First, there are normal variations in skin thickness, for example, the thickness of the sole versus the dorsum of the foot. Second, skin has elastic rebound that varies with age. Third, there are variations in the tightness of the attachment of the skin, for example, the tightness of the attachment of the skin of the elbow versus the skin of the scalp. Therapists can also assess the level of moisture on the skin surface and the hydration of the skin itself because these may reflect a client's circulatory, trophic, or nutritional status. Finally, therapists may also be able to distinguish between the epidermis and the dermis by using gentle horizontal drag at the very surface of the skin.

Therapists can assess segmental or nerve root dysfunction and imbalance of visceral function by noting

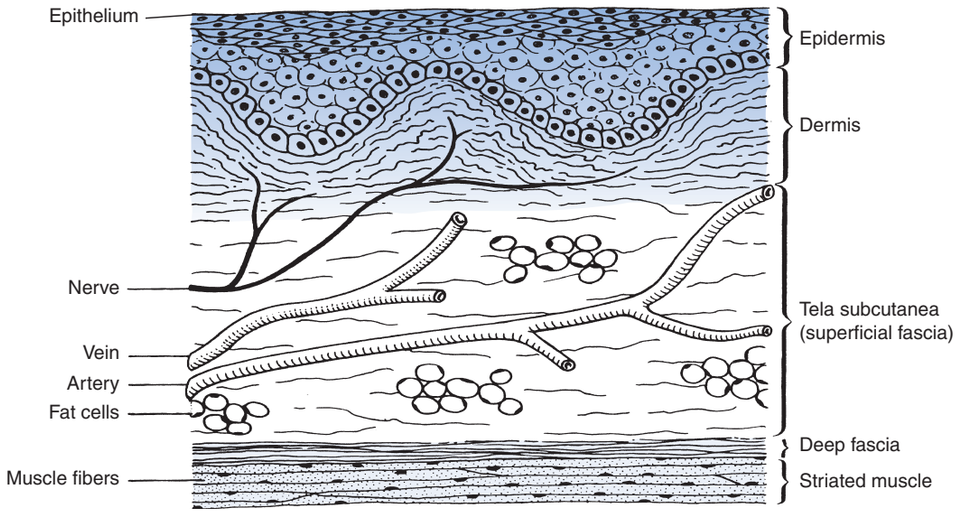


**Figure 5-1** Skin layers. (From Thomson JS. *Core Textbook of Anatomy.* Philadelphia: J. B. Lippincott Company; 1977:15. Used with permission of Lippincott Williams & Wilkins.)

whether there is tightness or resistance during the following sequence of movements[4,8,9,16,24–26]:

1. Stretch the skin horizontally in one direction at a time without gliding or engaging underlying issues.
2. Let the skin recoil.
3. Stretch the skin, and sustain this position at the barrier.
4. Note how soon the skin begins to elongate.

### Superficial Fascia

Therapists can engage the superficial fascia and the fat deposits it contains by increasing the compressive force they apply.[4,8,9,16,24–26] They can try to gauge the "turgor," or fluid pressure, of the tissues since edema often deposits into this tissue layer. They can also estimate the thickness of the superficial fascial layer by comparing different regions. The mobility tests outlined in Steps 1 to 4 above are also appropriate for assessing the superficial fascia. In addition, therapists can test the mobility of the superficial fascia by folding it or by lifting and rolling it over the surface of the underlying tissues. See Skin Rolling in Chapter 10, Connective Tissue Techniques. Therapists should compare the results they obtain for superficial fascia with those they obtained for the skin.

### The Investing Layer of the Deep Fascia

The investing layer of the deep fascia is smooth, firm, and continuous and lies between the superficial fascia and muscle.[4,8,9,16,24–26] Consequently, therapists may need practice to locate it precisely. The client examination procedure for connective tissue massage includes the assessment of the investing layer of the deep fascia. Therapists use techniques similar to those for the more superficial layers, described earlier, to assess the mobility of this connective tissue layer. The difference between these two approaches is that assessing the investing layer of the deep fascia requires more refined palpation skills because there is more intervening tissue. Tissue restrictions identified by therapists will often correlate with the restrictions that they find in the more superficial layers. These restrictions may indicate underlying muscle tension, segmental dysfunction, or visceral imbalance.

### Muscle

Therapists assess resting muscle tension during palpation by noting a muscle's response to the compressive and shearing forces that they deliver with their finger(s) or hands.[4,8,9,16,24–26] During palpation, their hand(s) may compress the whole muscle or bow it. They can also slowly enter the muscle tissue and tease its fibers apart using their fingers or thumbs. The higher the resting level of tone, the denser and harder the tissue will be on palpation. Increases and decreases in muscle resting tension are relative states because degrees of tone vary greatly from one person to another and between one segment of an individual's body and another. Spasm is more dramatic and, thus, more readily distinguished by therapists. Elevated resting tone can result from a wide variety of clinical conditions, including injury, degenerative diseases, and stress.

In addition to assessing muscle resting tension during the palpation of muscle, therapists can note whether

high turgor (fluid distention) is present since this can indicate a postexercise condition or an inflammatory condition.[4,8,9,16,24–26]

### Periosteum

This tissue layer is only accessible to palpation in areas where there is no overlying muscle.[4,8,9,16,24–26] Therapists can use compressive fingertip force to palpate the thin, dense, spongy layer superimposed on the hardness of the underlying bone.

## Critical Thinking Question

What palpation techniques do therapists use to assess each of the soft tissue layers? Copy Figure 5-1, and label it with the relevant palpation techniques.

## *Tissue Mobility and Restrictive Barriers*

### Normal Soft Tissue Range of Motion

Soft tissues have an available range of motion that is comparable to the range of motion available in joints.[4,8,9,16,24–26] Within this range of motion, normal soft tissue has three barriers, or resistances, that can limit movement (Figure 5-2). Therapists are "engaging" these tissue barriers at the point when they palpate a resistance to tissue motion. The physiological barrier (Ph) is the resistance that determines the range of motion that is available under normal conditions. In other word, the tissue's range of motion lies between the two physiological barriers, with the least amount of resistance being apparent at the midrange (M). The elastic barrier (E) is the resistance that therapists feel at the end of the passive range of motion when they have taken the "slack" out of or "engaging" the tissue. The anatomical barrier (A) is the final resistance to normal range of motion that the bone, ligament, or soft tissue can provide. Motion beyond the anatomical barrier results in tissue damage.

### Restrictive Barriers

**Restrictive, or pathological, barriers in soft tissue** occur when soft tissue dysfunction is present.[4,8,9,16,24–26] Restrictive barriers may occur in skin, fascia, muscle, ligament, joint capsule, or a combination of these tissues. They can be located anywhere between the normal physiological barriers, can limit the available range of motion within the tissues, and can alter the position of the midrange. Furthermore, the presence of a restrictive barrier will change the quality of the movement and the "feel" at the end of the tissue range of motion. This is similar to the abnormal end feels therapists observe in joints. An example of a restrictive barrier (R) and its impact on the position of the midrange (M2) appears in Figure 5-3.

### Barrier-Release Phenomenon

Therapists engage the tissue barrier at the point at which therapists palpate a resistance to tissue motion.[4,8,9,16,24–26] If therapists sustain the pressure on the tissue barrier, a "release" may occur after a latency period that will vary with the nature of the tissue and its state of health. This release results in a reduction of the resistance that will enable therapists to move the tissue beyond the location of the original barrier without increasing the pressure of palpation. This phenomenon is called the **barrier-release phenomenon**.

Different types of tissue will respond differently to sustained pressure.[4,8,9,16,24–26] For example, connective tissue is most responsive to sustained pressure and will demonstrate a slow, palpable stretch of tissues called creep or viscoelastic creep. This stretch occurs beyond the elastic barrier (E) shown in Figure 5-3. In the case of pathological or restrictive barriers, this release can last for up to 30 seconds or longer and can result in normalized tissue mobility and pain reduction. Since connective tissue forms a portion of all soft tissues, some creep will be evident in all soft tissues in proportion to the amount of connective tissue that is present in that tissue.

Therapists can observe the barrier-release phenomenon during their application of horizontal drag, vertical compression, or shear forces to the tissues using either small or large contact surfaces.[4,8,9,16,24–26] Consequently, they can use palpation to identify the feel at the end of the available range of motion of tissue using a variety of palpation techniques including digital compression or a palmar drag on the superficial fascia. The barrier-release phenomenon is

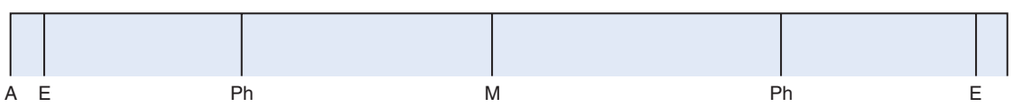


**Figure 5-2** Normal tissue barriers. A, anatomical barrier; E, elastic barrier; Ph, physiological barrier; M, midrange. (Reprinted with adaptations from Greenman PE. *Principles of Manual Medicine.* 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 1996:43. Used with permission of Lippincott Williams & Wilkins.)


**Figure 5-3** Restrictive tissue barriers. A, anatomical barrier; E, elastic barrier; Ph, physiological barrier; R, restrictive barrier; M, midrange; M2, pathological midrange. (Reprinted with adaptations from Greenman PE. *Principles of Manual Medicine.* 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 1996:43. Used with permission of Lippincott Williams & Wilkins.)

most useful when palpating connective tissue, but therapists can also apply it to any tissue or structure.

### Palpation of Tissue Mobility

Therapists can apply a compression or drag force, or a combination of the two, to a given tissue or structure within a client's body and observe the resulting movement.[4,8,9,16,24–26] In doing so, they can observe whether the normal range of motion is present in the tissues or whether restrictive barriers exist. If therapists palpate a restrictive barrier, they must note the available range of motion in the tissues, the quality of movement through the range of motion, and the feel of the point at which they engage the restrictive barrier.

## Critical Thinking Question

What are the similarities and differences between the range of motion available in joints and the range of motion of soft tissue?

### *Anatomical Structures*

The ability to palpate anatomical structures systematically is an absolute prerequisite for therapists who use massage.[3–38] This is the case because this ability has a direct impact on the accuracy of the therapists' examination using palpation, the effectiveness of the massage techniques they perform, and whether the client achieves treatment outcomes. The palpation of anatomical structures, detailed in comprehensive texts on this topic, involves the ability to discriminate between tissue types and to distinguish a structure from its surrounding structures with accuracy. Through palpation, therapists can identify bone, joint space (joint line), ligament, tendon (including junctions to both periosteum and to muscle), aponeurosis, fascia (septae, sheathes, retinacula), nerves, vessels, and viscera. Each anatomical structure has a characteristic "feel," which stems from its structure and histology. Therapists need to use compressive contact when they palpate anatomical structures. They also need to select contact surfaces and levels of pressure for palpation based on the structure that they are palpating.

### *Body Rhythms*

Therapists assess **pulses** and **respiratory rhythms** using static palpation with minimal to moderate compression and a contact surface of appropriate size.[3–38] The amount of force they apply during the palpation of pulses is important because the use of excessive compression can result in inaccurate findings. Therapists assess pulses using a single hand. By contrast, they can use two hands, placed on opposite sides of the ribcage, to produce a three-dimensional test when they are palpating respiratory rhythms. Therapists can palpate both pulse and respiration at a distance to the site, although this technique sometimes confuses novices. Therapists with advanced skills or specialized training can palpate more subtle pulsations of inherent tissue motions using a broad-contact static palpation.

### *Tremors and Fasciculations*

**Fasciculations** are localized, subconscious muscle contractions.[3–38] They do not involve the entire muscle because they result from the contraction of the muscle cells innervated by a single motor axon. **Tremors**, by contrast, are rhythmic movements of a joint that result from involuntary contractions of antagonist and agonist muscle groups. Therapists can palpate both tremors and fasciculations statically with minimal to moderate compression and contact surfaces of varying sizes.

### *Vibration*

Therapists can palpate two types of vibration: **crepitus** and **fremitus**.[3–38] Crepitus is a vibration of variable fineness that is associated with a roughened gliding surface of a tendon, a tendon sheath, or the articulating surfaces of a joint. Therapists can sometimes hear crepitus, in addition to

palpating it. Fremitus is another palpable vibration. Therapists can palpate this pulmonary vibration over the ribcage as the client speaks or vocalizes.

## Client's Response to Palpation

Therapists must observe and interpret the different verbal and physiological responses that palpation can evoke in a client.[3–38] **Local reflex signs** include discoloration of the skin (blanching or flushing) or more general autonomic responses such as sweating and nausea. Neuromuscular responses include twitching, spasm, or clonus. Clients may indicate that they are experiencing pain by grimacing, vocalizing, or making sudden involuntary movements.

Therapists must remember that pain is a common response to palpation, which they need to respect and observe carefully. Therapists can also quantify pain with, for example, a 4-point rating scale for grading tenderness or visual analog scales. The various types of pain responses differ in their significance and reliability. Tenderness to deep palpation, for example, is an unreliable finding since tenderness can be referred from other sites. Pain on percussion may have specific meaning for certain musculoskeletal conditions. Finally, during palpation, therapists need to be aware that palpation itself can sometimes produce negative or positive changes in the tissues they are palpating.

In summary, Box 5-2 outlines some of the body structures and functions that therapists assess using palpation.

**Box 5-2 Selected Impairments Evaluated through Palpation**

- Abnormal connective tissue density[3–38]
- Abnormal levels of resting muscle tension
- Abnormal neuromuscular tone
- Adhesions
- Impaired extensibility of contractile and noncontractile tissues
- Impaired integrity of contractile and noncontractile tissues
- Decreased rib cage mobility
- Fascial restrictions
- Muscle spasm
- Pain
- Scarring
- Swelling: edema, effusion, lymphedema
- Trigger points

### Critical Thinking Question

What are the common "objects of palpation"? Which palpation techniques and types of force of palpation do therapists use to assess these objects of palpation?

# MUSCULOSKELETAL EXAMINATION

## Adhesions and Scarring

### *Definitions and Etiology*

#### Scar

A **scar** is the fibrous tissue that replaces normal tissues that a burn, wound, surgery, radiation, or disease has destroyed.[39]

#### Adhesions

Like scars, **adhesions** result from the replacement of normal tissue with connective tissue after a burn, wound, surgery, radiation, or disease destroys the original tissues.[3–39] Adhesions may be fibrous or fibrinous. Fibrinous adhesions have fine bands of fibrin that form as a result of an exudate of plasma or lymph or an extravasation of blood. Fibrous adhesions come from the organization of fibrinous adhesions into fibrous strands. Unlike scarring, adhesions are characterized by a loss of mobility of tissues that normally glide or move in relation to each other. Adhesions can contribute to impaired muscle, joint, and connective tissue integrity, which is described in detail in other sections of this chapter.

### *Overview of Examination Techniques*

Adhesions are of greater clinical significance than scars since they are associated with impaired tissue mobility.[3–38] The measurement of adhesions through observation and palpation is, unfortunately, less accurate than that of scars. Therapists can confirm the presence of scar through visual inspection, an important component to include in the measurement of scars since many clients forget scars. Ultrasonography, magnetic resonance imaging, and arthroscopy are more accurate, although clinically less practical, approaches. Therapists with training in visceral manipulation can perform more detailed examinations of visceral adhesions.

**Theory in Practice 5-1**

**Steps in Performing Palpation of Scarring**

1. Position the patient so that the scar is not in a stretched position and is readily accessible to you.[3–38]
2. Prior to initiating palpation, explain the purpose and procedures of palpation to the patient. In particular, instruct the patient to tell you when she feels any discomfort. In doing so, inform her that you will cease applying pressure as soon as she indicates discomfort, so that she does not experience undue discomfort. This is especially important if the patient has reported that the scar is painful.
3. Begin palpation using a light pressure. Then, gradually increase the depth of palpation.
4. Assess whether the scar tissue moves as freely as the surrounding tissues. As you palpate the scar, identify differences in the mobility of different areas of the scar tissue. In addition, note areas in which the scar appears to be adherent to adjacent or deeper tissues. Document this information using the positions of a clock, for example, 3:00 (with 12:00 being in the cephalad direction).
5. During palpation, ask the patient to report when she experiences pain at the site of the scar or elsewhere during palpation. Movement of the scar should be pain free.
6. Identify areas of the scar that are puckered, and document this information.
7. Adjuncts to palpation used to assess changes in the dimensions of scars include the measurement of the depth of the scar using a ruler and photography. Follow your facility's guidelines for obtaining the patient's written permission for photographs.

# Connective Tissue Integrity

## *Definitions and Etiology*

### Fascial Restrictions

**Fascial restrictions** are the adhesion of one fascial layer to another with the associated development of elastocollagenous cross-links and loss of fluid consistency of fascial ground substance.[25,37–56] Fascial restrictions may be caused by trauma, adhesion, inflammatory or infectious processes, osseous restrictions, chronic fascial compartment syndromes, neurological or circulatory compression syndromes, or postural malalignment such as leg length discrepancy, pelvic malalignment, and dental malocclusion. Finally, fascial restrictions may cause pain, impaired motion, and general dysfunction throughout the body. These symptoms may occur at a distance from the restriction and may result in impaired cellular metabolism, nutrition, elimination, respiration, or lymphatic flow.

### Abnormal Connective Tissue Density

**Abnormal connective tissue density** is irregular connective tissue remodeling that occurs during the consolidation and maturation stages of connective tissue healing.[25,37–56] This can be associated with chronic orthopedic injuries, including strains, fractures, and repetitive strain injuries, such as tendinitis, tenosynovitis, bursitis, and plantar fasciitis, in which there is ongoing microtrauma, low-grade inflammation, and tissue remodeling.

## *Overview of Examination Techniques*

Techniques for evaluating connective tissue impairments include visual inspection of the client's static and dynamic postural alignment; palpation of tissue, skin mobility, and vasomotor response; and assessment of craniosacral rhythm characteristics.[3–56] Therapists need to evaluate the client's entire body, regardless of the client's complaint, because imbalances in the fascial system can have significant effects at locations other than the site of the restriction.

# Posture

## *Definitions and Etiology*

### Posture

**Posture** is the positioning and alignment of the skeleton and associated soft tissues in relation to gravity, the body's center of mass, and the body's base of support.[6,27–30,39,57–71]

### Postural Malalignment

**Postural malalignment** is abnormal joint alignment or deformity within a bone.[6,27–30,39,57–71] Since all tissue growth and repair can be influenced by mechanical loading and body posture, postural malalignment can contribute to the development of neurovascular and musculoskeletal dysfunction. This contribution can be direct or as a result of the compensatory motions or postures that can accompany postural malalignment. For example, chronic placement of the head anterior to the body's center of gravity is a common postural malalignment that is associated with neurological and musculoskeletal dysfunction.

## *Overview of Examination Techniques*

Soft tissues exert a stress on bony structures; consequently, pathological changes in the tension of muscles and connective tissue can affect bony alignment.[6,27–30,39,57–71] The purpose of the postural analysis is, therefore, to document both soft tissue and bony structure and alignment. This information provides objective data that therapists can use to corroborate or refute findings from other examination techniques and the client's functional limitations. This will assist in the identification of appropriate outcomes (Box 5-3).

Visual inspection of the symmetry of bony landmarks, muscle contours, and other tissues with the client in static postures, such as sitting, standing, or lying, is the common clinical approach to assessing postural alignment.[6,27–30,39,57–71] Visual inspection of dynamic posture is of greater importance in the assessment of fascial restrictions. The technique of visual inspection can be refined through the use of postural grids, photography, and various posture analysis forms such as the Portland State University Posture Analysis Form. In addition, therapists can obtain information on the client's postural awareness during the client interview.

Goniometry, plumb lines, inclinometers, tape measures, and video image and frame analysis are among the tools that are available for quantifying postural malalignment.[6,27–30,39,57–71] For example, sagittal plane postural alignment of the head and shoulder in relationship to the lateral malleolus can be measured using a carpenter's tri-square with a line level attached to the horizontal arm and a goniometer with a line level attached to the horizontal arm.

More sophisticated measures of postural alignment include three-dimensional electrogoniometers, such as the Metrecom Skeletal Analysis System; a force platform; X-ray line drawing analysis for sagittal plane spinal displacement; and visual estimation of lumbar lordosis from radiographs (which can be inaccurate and unreliable ).[6,27–30,39,57–71] Dynamic postural analysis can be performed using three-dimensional computer-assisted motion analysis, with or without electromyography. Finally, postural alignment during functional activity can be assessed using measures such as the Ovako Working Analysis System.

### Box 5-3 Incorporating Postural Data into Outcomes

**Subjective Findings:** Client reports pain after performing keyboarding tasks for 5 minutes.

**Objective Findings:** Client has an anterior head posture; ear lobe is 2.5 cm anterior to the acromion.

**Analysis:** Client's anterior head position is biomechanically inefficient, decreases her endurance in performing keyboarding tasks, and contributes to her pain as a result of excessive loading of the posterior cervical and shoulder musculature. Correction of the soft tissue restrictions that contribute to this posture may reduce the client's complaints of pain and facilitate enhanced alignment of head and cervical spine, biomechanical efficiency, and work tolerance.

**Functional Outcome:** Client will be able to perform keyboarding tasks with the ear lobe in vertical alignment over the acromion for 30 continuous minutes without complaints of pain.

### Theory in Practice 5-2

### Using Visual Postural Analysis

#### Practitioner's Position for the Postural Analysis

Anterior view: The practitioner stands directly in front of the patient at a distance of approximately 5–8 feet, with the patient in standing or sitting.[6,27–30,39,57–71] If the patient is in supine, the practitioner stands at the foot of the treatment table. Standing on a stool may offer a clearer view.

Posterior view: The practitioner stands directly behind the patient at a distance of approximately 5–8 feet, with the patient in standing or sitting. If the patient is prone, the practitioner stands at the foot of the treatment table (standing on a stool may offer a clearer view).

Lateral view: The practitioner positions himself to the side of the patient in alignment with the patient's external auditory meatus for the examination of the lateral view with the patient in standing or sitting. If the patient is in side lying, the practitioner is positioned at the side of the treatment table (standing on a stool may offer a clearer view). Standing at the side of the treatment table may provide a less obstructed view of the patient's upper body, compared with the anterior view, if the patient has a large abdomen or considerable amounts of pectoral or breast tissue.

#### Patient's Position for the Postural Analysis

Observation of the patient from different views and in different positions can provide the practitioner with a greater understanding of the patient's postural alignment. For example, a patient whose postural alignment differs in standing

versus supine may have a pelvic malalignment, a leg length discrepancy, muscular weakness, or an impaired postural awareness. In addition, the practitioner can also identify whether the patient has a pelvic malalignment or a leg length discrepancy by comparing the patient's postural alignment in sitting and standing. If the patient is non-ambulatory, the practitioner may use sitting and supine for this purpose.

### Steps in Performing a Postural Analysis

1. Ask the patient to remove her shoes and don clothing or a gown that allows the therapist to view landmarks, while ensuring appropriate draping.
2. Select a view to assess, for example the anterior view, and identify the appropriate position for doing so.
3. Position the posture grid or plumb line.
4. Position the patient in relation to the posture grid or plumb line so that the selected view of the patient is unobstructed and the posture grid or plumb line provides an appropriate frame of reference.
5. Ask the patient to assume a relaxed posture, rather than what she thinks is "good" posture. Allow the patient to settle into that position for a minute to get a more accurate representation of her usual posture. If this is painful, then decrease the amount of time the patient spends in this position.
6. Assume the appropriate position from which to observe the landmarks for the selected view.
7. Perform the visual inspection of the selected view, identifying the positions of the landmarks listed in Landmarks for Visual Postural Analysis and noting the symmetry of body contours and muscle bulk throughout the patient's body. Ensure that you perform a bilateral comparison wherever this is appropriate.
8. Confirm or refute the findings of visual analysis with palpation.
9. Document the findings of visual analysis.
10. Note findings that will be an indication for further patient examination using other tests and measures.
11. Reposition the patient for the next view in the assessment.

### Landmarks for Visual Postural Analysis

#### *Anterior View*

Head and Neck

1. Orientation of the end of the nose with the manubrium, xiphoid process, and umbilicus (the umbilicus is often not in vertical alignment with these other landmarks)
2. Vertical alignment of the head, for example, excessive lateral flexion or rotation
3. Level of the eyes
4. Vertical alignment of the jaw
5. Contours of trapezius muscle

Upper Extremities

1. Carrying angle of elbows (5–15 degrees is the normal range of the carrying angle for an elbow)
2. Levels of hands (used in identifying asymmetrical shoulder levels)
3. Direction of palms (used in identifying asymmetrical shoulder rotation)

Trunk

1. Trunk in vertical alignment: note asymmetry of skin folds or the distances of the patient's arms to her trunk
2. Level of acromioclavicular joints
3. Level and length of clavicles
4. Sternum and costocartilage aligned: note superior, inferior, or lateral deviations of these landmarks
5. Ribs aligned and symmetrical bilaterally
6. Differences in weight bearing on the lower extremities as reflected by the position of the trunk over the extremities

Lower Extremities and Pelvis

1. Levels of the anterior superior iliac spines
2. Torsion of the tibia or femurs
3. Orientation of the knees, for example, varus or valgus
4. Orientation of the patellae
5. Levels of the fibular heads
6. Levels of lateral malleoli
7. Levels of the medial malleoli
8. Foot angle (10 degrees of external rotation or toeing out is normal)
9. Orientation of the arches of the feet, for example, neutral, pronated, supinated, pes cavus, or pes planus with the feet in their usual posture and then with the great toes aligned; if the patient wears orthotics, it may be appropriate to observe foot position with the patient's shoes on.

#### *Lateral View*

1. Deviation from an imaginary vertical line running through the following landmarks: ear lobe through the bodies of the cervical vertebrae, through the acromion process, through the lumbar vertebrae, through the highest point of the iliac crest, through the hip joint, anterior to the knee joint, and anterior to the ankle joint
2. Position of the glenohumeral joint
3. Position of the sternum: note if it is overly prominent or depressed
4. Tilt of the pelvis
5. Alignment of the knees: note recurvatum or excessive flexion

***Posterior View***

Head and Neck

1. Vertical alignment of the head

Upper Extremities

1. Level of the shoulders

Trunk

1. Levels and alignment of the spines and inferior angles of the scapulae (the scapulae should rest on the thorax between the levels of T2 and T8; note whether the scapulae are abducted, adducted, elevated, or depressed)
2. Position of the scapulae against the thorax: note if they are winging
3. Distance of the vertebral borders of scapulae from the thoracic vertebrae
4. Vertical alignment of the spine: note any lateral curvature
5. Distance between the twelfth rib and the iliac crest

Lower Extremities and Pelvis

1. Level of the iliac crests
2. Level of the posterior superior iliac spines
3. Levels of the gluteal folds
4. Levels of the knee joints
5. Angle of Achilles tendons (should be vertical)
6. Position of hindfoot with the feet in their usual posture and then with the great toes aligned. If the patient wears orthotics, it may be appropriate to observe foot position with the patient's shoes on. Note whether the hindfoot is in varus or valgus.

**Note**

Pelvic malalignment or a small hemipelvis can present as changes in thoracic alignment in sitting. In addition, consider a more detailed examination of pelvic misalignment if the patient's anterior superior iliac spines or posterior superior iliac spines are asymmetrical. Therapists can refer to other sources for detailed guidelines on the examination of pelvic alignment.

# PSYCHONEUROIMMUNOLOGICAL EXAMINATION

## Stress

### *Definitions and Etiology*

#### Chronic Stress

**Chronic stress** is a prolonged and heightened state of arousal that has negative physiological and psychological consequences.[72–112] Chronic stress responses occur over the cognitive, physiological, affective, or behavioral domains and may have consequences such as impaired cognitive function, depression, anxiety, muscle tension, and impaired social functioning.

#### Stress Response

**Stress response** is the individual's cognitive, physiological, affective, or behavioral response to the stressor or stress-provoking situation.[72–112]

#### Cognitive Transactional Model of Stress

The **Cognitive Transactional Model of Stress** views stress as the condition that results when a person's interactions with his environment leads him to perceive a discrepancy, whether real or not, between the demands of the situation and the resources of his biological, psychological, or social systems.[72–112]

#### Physiological Model of Stress

Hans Selye discovered that the adrenal cortex and neuroendocrine and immune systems interact during stress, a finding that current research supports.[72–112] He defined stress as the body's automatic response ("fight or flight") to a demand that is placed on it. Selye also made the distinction between negative and positive stress (distress and eustress, respectively).

#### Life Events Model of Stress

Holmes and Rahe defined a model of stress that examined the nature and consequences of negative life events and proposed that interpersonal stressors are predictive of increases in disease activity.[72–112]

Chronic psychosocial stress has numerous pathophysiological effects that may stem from excessive sympathetic nervous system activation.[72–112] In particular, adrenal glucocorticoid hormones may play a major role in the stress response because of their profound effects on mood, behavior, neurochemical transmission, and neuroendocrine control. The pathophysiological effects of chronic stress include insulin resistance, hyperinsulinemia, coronary heart disease risk, infertility in females, therapy-resistant periodontitis, and impaired hippocampus-mediated memory processes. In children, chronic stress may be associated with impaired mental and affective stability, integrity, and development.

Because of the subjective nature of stress, clients' perceptions of their symptoms and stress levels are a critical component of the client examination.[72–112] Client interviews can elicit clients' reports of physical, mental, emotional, and behavioral symptoms of stress and descriptions of the situations they perceive to be stress provoking. Therapists can use a visual analog scale to obtain a basic

rating of the client's perceived stress level. There are also numerous standardized self-report stress-rating questionnaires that therapists can use to assess their clients' perceived level of stress and the factors contributing to the stress that their clients experience. These tests provide a well-defined set of information and are usually designed and validated for a specific population. Therapists who wish to use a standardized measure of stress should consult the manual for details of the professional training required prior to administering the measure. This will enable them to determine whether their training and scope of practice allow them to administer the measure. Some of these measures use dominant models of stress as their basis. For example, the Schedule of Recent Experience, Impact of Events Scale, and Social Readjustment Ratings Scale are classic measures based on Holmes and Rahe's Life Events Model of Stress. The Cognitive Transactional Model of Stress provides the basis for the Hassles and Uplifts and the Ways of Coping Questionnaire from Folkman and Lazarus.[95] In addition, there are health-related stress questionnaires such as the Cardiac Event Threat Questionnaire. Buros Mental Measurement Yearbook[96] is a useful source of information on standardized stress questionnaires that includes the test population, test purpose, test details, and reviews. Box 5-4 lists some of the many tests described in Buros.[96]

Therapists can also use any of the range of physiological measures of chronic stress that are available.[72–112] Clinical measures include heart rate, systolic and diastolic blood pressure, finger pulse volume, skin conductance levels, and finger temperature. Electromyography, especially lateral frontalis electromyogram responses, is an indicator of stress. Laboratory measures of blood samples include levels of lipid peroxides in venous blood samples; levels of the stress-related hormones prolactin, cortisol, and testosterone; and glycated hemoglobin levels. Finally, analysis of saliva identifies salivary cortisol levels, a common physiological indicator of stress.

**Box 5-4 Examples of Standardized Measures of Stress from the Buros Mental Measurement Yearbook[96]**

- Adolescent Coping Scale
- Coping Inventory for Stressful Situations
- Coping with Stress
- Daily Stress Inventory
- Life Stressors and Social Resources Inventory–Youth Form
- Personal Stress Assessment Inventory
- Questionnaire on Resources and Stress
- Stokes-Gordon Stress Scale
- Stress Analysis System
- Stress Audit
- Stress Impact Scale
- Stress Indicator and Health Planner
- Stress Management Questionnaire
- Stress Resiliency Profile
- Stress Response Scale
- Understanding and Managing Stress

# MULTISYSTEM EXAMINATION

## Pain

### *Definitions and Etiology*

#### Pain

**Pain** is an unpleasant sensation associated with actual or potential tissue damage that is mediated by specific nerve fibers to the brain where its conscious appreciation may be modified by various factors.[27–30,39,40,113–155]

#### Acute Pain

**Acute pain** is pain provoked by noxious stimulation produced by injury and/or disease with unpleasant sensory and emotional experiences.[27–30,39,40,113–155]

#### Chronic Pain

**Chronic pain** is pain that persists beyond the usual course of healing of an acute disease or beyond the reasonable time in which therapists expect the injury to heal.[27–30,39,40,113–155] There is some ambiguity in the definition of chronic pain. Some authors define it in terms of duration of pain, with a lower limit of duration ranging from 6 weeks to 6 months. Conversely, others define chronic pain in terms of an increasing dissociation from the physical etiology and increasing affective and cognitive dimensions of pain (see the definition of Chronic Pain Syndrome).

#### Chronic Pain Syndrome

**Chronic pain syndrome** is a clinical syndrome in which clients present with high levels of pain that is chronic in duration, in conjunction with functional limitations and depression.[27–30,39,40,113–155] This clinical pattern is seen more often in younger and middle-aged clients than in geriatric clients.

### Nociceptive Pain

**Nociceptive pain** is the sensitization of peripheral nociceptors as a result of injury to a muscle or a joint that causes an increased release of neurotransmitters in the dorsal horn of the spinal cord.[27–30,39,40,113–155] The sensitized dorsal horn neurons demonstrate an increased background activity, an increased receptive field size, and increased responses to peripherally applied stimuli. Nociceptive pain may be implicated in the majority of the clients seen in clinical practice.

### Neurogenic Pain

**Neurogenic pain** is pain that occurs as a result of noninflammatory dysfunction of the peripheral or central nervous system that does not involve nociceptor stimulation or trauma.[27–30,39,40,113–155]

### Referred Pain

**Referred pain** is pain that the client feels at another location of the body that is at a distance from the tissues that have caused it.[27–30,39,40,113–155] This occurs because the same or adjacent neural segments supply the referred site. Therapists can identify referred pain because clients report pain in a generalized area, which they feel deeply, that radiates segmentally without crossing the midline and that has indistinct boundaries.

### Radiculopathy

**Radiculopathy** is pain that the client feels in a dermatome, myotome, or sclerotome because of direct involvement of a spinal nerve or nerve root.[27–30,39,40,113–155] It is also known as radicular or nerve root pain.

- **Dermatomal pain**: A **dermatome** is an area of skin supplied by one dorsal nerve root.[27–30,39,40,113–155] Injury of a dorsal root can result in sensory loss in the skin or can be experienced by the client as a burning or electric pain. For example, irritation of the C7 nerve root can lead to sensory changes in the C7 dermatome: lateral arm and forearm to the index, long, and ring fingers on the palmar and dorsal aspect.
- **Sclerotomal pain**: Pain in a sclerotome, an area of bone or fascia innervated by one segmental nerve root.[27–30,39,40,113–155] For example, hip pain can be referred to the groin, sacroiliac joints, lumbar spine, knee, or ankle.
- **Myotomal pain**: Pain in a myotome, a group of muscles supplied by one nerve root.[27–30,39,40,113–155] For example, injury to the teres minor can result in referred pain near the insertion of the deltoid.

### Visceral Pain

**Visceral pain** is pain in areas of the viscera supplied by a nerve root.[27–30,39,40,113–155] For example, injury to the small intestine can refer pain to the same area supplied by the T9–10 dermatome: an area encircling the trunk reaching the level of the umbilicus.

### Trigger Point Pain

Referred **trigger point pain** arises in a trigger point, but the client feels it at a distance that is often entirely remote from its source.[23–28,113–155] The pattern of referred pain relates to its site of origin. The distribution of referred trigger point pain rarely coincides entirely with the distribution of a peripheral nerve or dermatomal segment. Untreated trigger points can be associated with pain syndromes that include, but are not limited to, radiculopathy, tennis elbow, tension headache, occipital headache, and frozen shoulder.

## *Overview of Examination Techniques*

Therapists have a variety of options for measuring the different aspects of a client's pain.[113–155] They can elicit the client's general experience of pain through pain interviews about the 24-hour pain behavior. They can augment this interview with the use of body diagrams that the client can use to map the locations and quality of pain. They can assess pain intensity using a visual analog scale, the Verbal Rating Scale, the Numerical Rating Scale, and the Descriptor Differential Scale. They can use the McGill Pain Questionnaire, the Verbal Rating Scale, the visual analog scale, the Pain Discomfort Scale, and the Descriptor Differential Scale to assess the affective component of pain (how the client behaves in response to pain). The impact of the client's pain on his or her level of function is often evaluated using standardized self-report measures such as the Oswestry Back Pain Questionnaire, the Sickness Impact Profile, the Dallas Pain Questionnaire, and the Millon Visual Analog Scale. Finally, pain that the client reports that remains constant, regardless of activity, rest, or sleep, may be from a nonmusculoskeletal cause, such as cancer, that warrants a referral to the client's physician for further assessment.

Physical tests that therapists use to identify pain syndromes include: neural tissue tension or provocation tests, active and passive moment analysis, and nerve or tissue palpation.[113–155] The client's sensitivity to the pressure of palpation can be quantified accurately and reliably (interrater reliability interclass correlation coefficients [ICCs] ranging from 0.75 to 0.84, intrarater reliability ICCs ranging from 0.64 and 0.96) using a pain threshold meter or pressure

algometer. The combination of client history and palpation is the primary clinical means of identifying trigger points, although the palpation of latent trigger points may be less reliable than that of active trigger points. The electrophysiological studies (nerve conduction) of electromyography and thermography are among the laboratory or instrumented tests used in the diagnosis of pain syndromes.

# Swelling

## *Definitions and Etiology*

### Swelling

**Swelling** is an abnormal enlargement of a segment of the body.[27,39,156–166]

### Edema

**Edema** is an accumulation of fluid in cells, tissues, or serous cavities.[27,39,156–166] Edema has four main causes: increased permeability of capillaries, decreased plasma protein osmotic pressure, increased pressure in capillaries and venules, and lymphatic flow obstruction.

**Theory in Practice 5-3**

**Using a Visual Analog Scale**

The visual analog scale (Figure 5-4) is a written rating scale of pain intensity that is widely used both clinically and in research because of the ease with which therapists can administer it.[113–155] The visual analog scale (VAS) consists of a straight line measuring 10 cm in length. "No pain" is at the left end of the line, and "the worst pain I have ever experienced" is at the right end. Test-retest reliability for the VAS has been reported as $r = 0.99$. Concurrent validity between the VAS and the Numeric Pain Rating Scale ranged between $r = 0.77$ to $r = 0.91$.

**Steps in Administering the Visual Analog Scale**

1. Explain the pain rating levels at both extremes of the scale to the patient.
2. Ask the patient to mark the line at the point that corresponds to the intensity of pain that she is experiencing at the time at which she is completing the VAS.
3. Measure the distance from the beginning of the line to the patient's mark; this is the value that represents the patient's intensity of pain.
4. On re-examination, present the patient with a new diagram rather than her previous pain rating.

### Effusion

**Effusion** is excessive fluid in the joint capsule, indicating irritation or inflammation of the synovium.[27,39,156–166]

### Lymphedema

**Lymphedema** is accumulation of abnormal amounts of lymph fluid and associated swelling of subcutaneous tissues that results from the obstruction, destruction, or hypoplasia of lymph vessels.[27,39,156–166]

### Dependent Edema

**Dependent edema** is an increase in extracellular fluid volume that is localized in a dependent area such as a limb.[27,39,156–166] Dependent edema can be associated with swelling or pitting.

### Pitting Edema

**Pitting edema** is edema that retains the indentation produced by the pressure of palpation.[27,39,156–166]

### Solid Edema

**Solid edema** is the infiltration of subcutaneous tissues by mucoid material.[27,39,156–166]

## *Overview of Examination Techniques*

Therapists can obtain the client's description of her swelling and related symptoms through the client interview, in conjunction with the use of a body diagram.[27,39,156–166] Visual inspection of swelling can assist therapists in determining how best to measure the client's swelling. Palpation of swelling provides data on the quality of the swelling and the degree of edema that is present. Grading scales for edema include a 4-point scale for the degree of pitting and a 3-point scale for stage of lymphedema. Therapists can measure the girth of swollen body segments using a flexible tape measure, jeweler's ring, or wire. Volumetric analysis, in which the amount of fluid displaced by the limb is measured, provides a simple means of quantifying the extent of swelling that is more appropriate for swelling of the extremities. Comparison of volumetric analysis and estimation of limb volume using measurements of the limb perimeter showed that there was no significant difference between the two measures of limb volume for the arm but that volumetric analysis was more reliable and accurate for the hand. Laboratory or instrumented measures of swelling include multiple frequency bioelectrical impedance analysis, magnetic resonance imaging, and laser-Doppler flowmetry.


**Figure 5-4** Visual analog scale for pain measurement.

## Theory in Practice 5-4

### Using a Pain Drawing

Practitioners often use the pain drawing to guide the patient systematically through a description of her pain and related symptoms.[113–155] The pain drawing that a patient produces on a body diagram can serve several purposes. First, practitioners can use it as an adjunct to the pain interview as a means of facilitating the patient's discussion of her symptoms. It is a simple and reliable method of identifying the location of a patient's pain and associated symptoms such as paresthesia and tightness. In addition, they can also use it to guide treatment planning and to document the patient's response to treatment.

#### Steps in Using the Pain Drawing

1. Provide the patient with a diagram of the human body (Figure 5-5) and colored pens.
2. Explain the purpose of the pain drawing and any predefined symbols, such as dotted lines, that represent pain and associated symptoms.
3. Inform the patient what time period the pain drawing is intended to represent. For example, this may be pain and symptoms experienced over the previous 24 hours. This time period will vary with the nature of the patient's clinical condition.
4. Ask the patient to indicate the location of any pain and associated symptoms that she has experienced during the specified time period on the diagram, using colors and predefined symbols. If the patient is unable to complete this task independently, the practitioner may provide the appropriate level of assistance.
5. When the patient has completed the pain drawing, discuss the drawing to clarify and expand on the information that the patient has provided. Practitioners can do this as part of the pain interview. Document this supplemental information on the pain drawing or elsewhere in

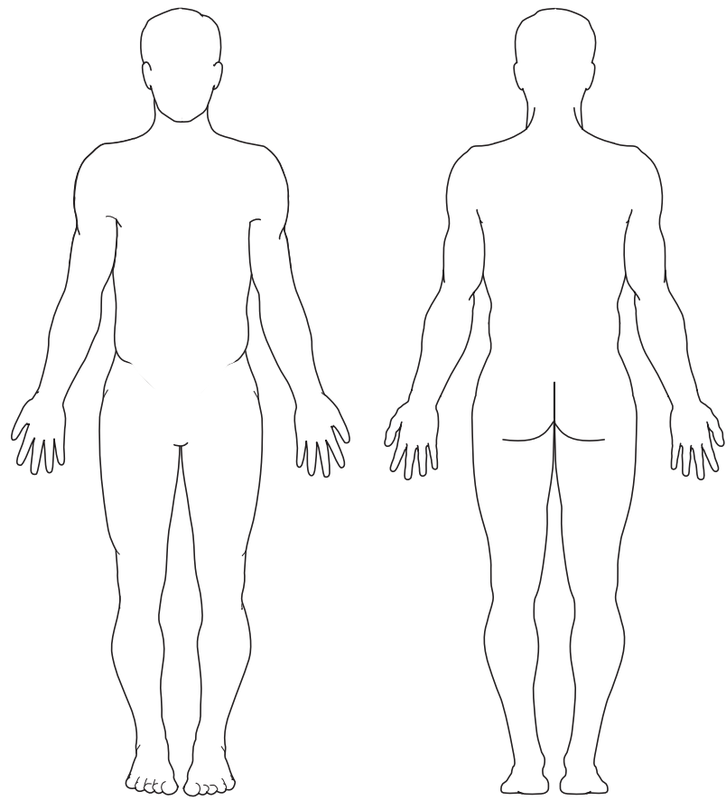

**Figure 5-5** Body diagram for the pain drawing.

the patient's chart. The section on general pain behavior in the pain interview notes some issues that may be worthy of additional attention depending on the patient's clinical condition.

The practitioner may wish to identify asymptomatic areas that are immediately adjacent to the symptomatic area on the pain drawing.

**Theory in Practice 5-5**

### Using Palpation for Pain

Practitioners can use palpation to obtain further information on the location of the patient's pain and the sensitivity of the patient's tissues.[113–155]

#### Steps in Performing Palpation for Pain

1. Ensure that your hands are warm and dry.
2. Position the patient in a comfortable position in which the area to be palpated is readily accessible to you.
3. Drape the patient appropriately (see Chapter 6, Preparation and Positioning for Massage).
4. Explain the purpose of palpation and the procedures to be followed to the patient.
5. Ask the patient to inform you when she experiences tenderness, a referral of pain, or tingling or any other symptoms as a result of your palpation.
6. Select the location where you will begin palpation based on the patient's reports of the locations of pain, patterns of referred pain, or areas of tissue tightness that may be contributing to a postural dysfunction.
7. Begin palpation using a light pressure. Gradually increase the depth of palpation because a rapid change of depth may elicit a guarding response.
8. As you palpate each location, ask the patient if pressure on a given area causes any tenderness, localized pain, or referred pain. Move between locations slowly to avoid eliciting a painful spasm.
9. Observe the patient for twitching, vasomotor responses, and changes in breathing.
10. As you progress with palpation, identify and palpate areas in which the there are abnormalities of tissue texture such as bogginess or taut tissue bands.
11. Increase the depth of palpation and repeat the process if palpation with light pressure does not reproduce the patient's symptoms or the results of this palpation are inconclusive.
12. In addition to palpating the locations of pain the patient has reported, you may also wish to palpate the following:
    (a) Trigger points that may refer to the painful areas
    (b) Related dermatomes
    (c) Related sclerotomes
13. Document all locations in which the palpation reproduces the patient's symptoms, and note the patterns of referred pain that result from palpation.

Note: Tenderness on palpation of a given area may be referred tenderness from another area and may not be a reliable finding. The practitioner needs to corroborate the findings of palpation for pain with other clinical tests and measures.

# CARDIOPULMONARY EXAMINATION

## Dyspnea

### *Definitions and Etiology*

#### Dyspnea

**Dyspnea** is shortness of breath, labored or difficult breathing, or an uncomfortable awareness of one's breathing.[39,167–187] Dyspnea is usually an indication of inadequate ventilation or insufficient amounts of oxygen in the circulating blood. Dyspnea is a complex sensation that involves: (a) the physiological and psychological events or stimuli preceding the development of dyspnea, (b) the characteristics of an individual or his or her environment that mediates his or her response to the dyspnea, and (c) the outcomes that result once the individual has reacted to the dyspnea.

### *Overview of Examination Techniques*

Clinical examination of a client with dyspnea can include visual inspection for posture used during respiration; quality, rate, and pattern of breathing; accessory muscle use; color; and affect.[39,167–187] Laboratory tests of decreased ventilation include arterial blood gases, which show oxygenation, acidosis, alkalosis, compensatory mechanisms, and buffer systems, and capnography, which determines levels of carbon dioxide.

There is only a fair association between perceived dyspnea and actual physiological lung function, possibly because of the different components that are the antecedents, mediators, and outcomes of dyspnea outlined earlier.[39,167–187] For this reason, self-report measures of dyspnea are important. Measures such as the British Medical Research Council Questionnaire, the American Thoracic Questionnaire, and

the Dyspnea Interview Schedule can assess the events or stimuli that precede the dyspnea. The American Thoracic Questionnaire, the Chronic Respiratory Questionnaire, the Dyspnea Interview Schedule, the Pulmonary Functional Status Scale, and the Therapy Impact Questionnaire may measure characteristics that mediate the dyspnea. The Dyspnea Visual Analog Scale, the Therapy Impact Questionnaire, and the Borg Perceived Exertion Scale measure an individual's reactions to dyspnea. In addition, the Therapy Impact Questionnaire, the Baseline Dyspnea Index, the Transition Dyspnea Index, the Chronic Respiratory Questionnaire, the Oxygen Cost Diagram, the Dyspnea Interview Schedule, and the Modified Medical Research Council Dyspnea Scale measure the consequences of an episode of dyspnea. Finally, since decreased exercise capacity is one of the consequences of dyspnea, measures of functional exercise capacity, such as the 6-minute walk test, can be a valuable inclusion.

## Rib Cage Mobility

### *Definitions and Etiology*

#### Rib Cage Mobility

**Rib cage mobility** is the capacity of the ribcage to move within the available anatomical range of motion during respiration, based on the arthrokinematics of the joints of the ribcage and the thoracic spine, and the ability of the periarticular connective tissue to deform.[39,167–187]

### *Overview of Examination Techniques*

Examination of rib cage mobility involves both visual inspection and palpation.[39,167–187] The visual inspection performed by therapists should include general posture, breathing pattern, chest wall shape, symmetry of chest wall movement, accessory muscle use, and muscle contours. Palpation of chest wall excursion during respiration should address lateral costal and diaphragmatic excursion, thorough palpation of the intercostal spaces, sternal motion, and apical motion. Therapists can also use palpation to assess the mobility of the thoracic spine, the costovertebral joints, and the sternocostal joints. Palpation of muscle tension in the accessory muscles of breathing, such as the sternocleidomastoid and the intercostal muscles, will complete the palpation process. Finally, therapists can quantify rib cage mobility by measuring ribcage excursion during respiration with a tape measure using a consistent measurement site and position.

# FUNCTIONAL EXAMINATION

## Self-Care Activities

**Self-care activities** refer to those daily tasks that an individual needs to perform in order to be independent.[188–203] These tasks include dressing, feeding, grooming, hygiene, functional mobility, and functional communication. Therapists consider an inability to perform any of these tasks a functional limitation. Furthermore, they are more frequently using standardized measures of self-care to assess the clients' functional limitations and their progress on the identified functional outcomes. For example, the Barthel Index is a self-care measure that consists of the following 10 items that represent basic self-care activities: feeding, wheelchair transfer, grooming, bathing, walking on level surface, climbing stairs, dressing, bowel control, bladder control, and toilet use. Although it is one of the oldest self-care measures, ongoing studies are evaluating its validity and reliability. The Barthel Index is still widely used for the examination of clients with strokes, hip fractures, liver transplants, Parkinson's disease, amputations, and other clinical conditions. The relevant sections on impairments discuss other self-care measures.

## Health-Related Quality of Life

**Health-related quality of life** can be an issue to address in the client examination for massage since the impairments described earlier can have an impact on the client's level of activity and participation in society.[204–223] Measures of health-related quality of life have a broader focus than self-care measures and they typically cover the domains of physical, psychological, emotional, and social function. For example, the Medical Outcomes Survey–Short Form-36 (MOS SF-36) is a frequently used health-related quality of life measure that researchers have validated for several diseases and translated into other languages. Box 5-5 lists other health-related quality of life measures. In addition, therapists are using disease-specific quality of life measures, such as the Rheumatoid Arthritis Quality of Life Scale, more frequently in clinical examination and studies.

# REVIEWING THE BASICS

The client examination plays a critical role in Outcome-Based Massage by providing the clinical findings on which therapists can base their confirmation of their

**Box 5-5 Selected Health-Related Quality of Life Measures**

These measures assess different components of quality of life.[204–223]

- Medical Outcomes Study Health Status Questionnaire
- Duke-UNC Health Profile
- The Sickness Impact Profile
- McMaster Health Index Questionnaire
- Functional Status Questionnaire
- Nottingham Health Profile

clinical hypothesis and their treatment planning. Consequently, therapists who are conducting client examinations with a view to using massage as a primary or complementary treatment modality need to expand the focus of their standard approach to examination to include the assessment of soft tissue dysfunction and the impairments that are relevant to the use of massage techniques.

Palpation provides an important means of assessing a variety of aspects of soft tissue function that can suggest the presence of impairments such as temperature, tissue mobility, fluid status, tissue texture, and tissue consistency. In addition, the client's response to palpation can give therapists other information about the client's presenting impairments. However, palpation is not the only means of assessing a client's impairments. Therapists can also extend their interpretation of the findings from standard musculoskeletal, neurologic, cardiopulmonary, and psychological tests and measures to include an analysis of the contribution of soft tissue dysfunction. Finally, the client examination conducted by therapists should also address the client's level of ability to perform functional activities and quality of life, so that therapists have data on which to base the identification of appropriate functional outcomes.

# Client Examination for Massage: Further Study and Practice

## UNDERSTANDING MUSCLE RESTING TENSION

### Definitions and Conceptual Framework

Traditionally, the literature describes muscle resting tension as the result of the biomechanical properties of muscle such as viscosity, elasticity, and plasticity. Furthermore, it notes that, in some situations, contractile activity can also contribute to resting tension. Clinicians know that the firmness and texture of skeletal muscle varies greatly from person to person.[23–28,34,39,98,332–340] Moreover, different muscles in the same client or the same muscle at different times can also vary in resting tension. Clinicians can observe the manner in which massage techniques can quickly produce dramatic changes in resting tension. These palpable changes in resting tension may relate to changes in a client's pain, other impairments, and level of activity.

One prevalent theory was that resting tension arises from a constant low-level contraction of skeletal muscle fibers, although recent research questions that theory.[23–28,34,39,98,332–340] The emerging conceptual framework is that muscle resting tension results from a complex interaction among several components: myofibril contractile tissue, connectin and titin, giant structural proteins of striated muscle, connective tissue and its components, and nerve. The framework described in this section takes into account some observations about skeletal muscle that clinicians can notice during palpation (Box 5-6).

### Biomechanical Contributions to Resting Tension

This category refers to the contribution to resting tension made by the physical substances contained in muscle.[23–28,34,39,98,332–340] It has also been termed viscoelastic tone or passive tone. Muscle is a tissue composed of "subtissues": water, simple organic molecules, complex unchained organic molecules, and more complex biopolymers. Each of these has different physical or material properties such as density, stiffness, and deformability. The behavior of muscle during palpation reflects the properties of these components (Figure 5-6).

**Box 5-6 Observations about Skeletal Muscle That Can Be Noted during Palpation[23–28,34,39,98,332–340]**

- Clinicians can change the shape of muscle by applying force.
- A deformed muscle reverts quickly to its former size and shape, although the muscle's shape and resting tension may change slightly.
- The texture of the same muscle can differ temporally. Sometimes, it feels softer, more flexible, and more liquid; at other times, it may feel harder, stiffer, and more solid. This texture is partly dependent on the muscle's position.
- The texture of a muscle can differ spatially. Relatively soft areas in a muscle may surround harder "knots."
- Clinicians can observe a wider range of textures across a selection of healthy clients. This range is along the same continuum from soft to hard.
- Fibers are commonly palpable in muscle at rest. These are similar to, but less pronounced than, those fibers clinicians feel when a working muscle contracts.
- Sometimes, a muscle that is "at rest" feels as though it is contracting.
- Palpation or massage can provoke a low-grade transient contraction. Therapists can sometimes observe a similar "twitching" when the muscle is at rest.
- After an injury, clinicians may find that the characteristic texture of muscle tissue is obscured. More specifically, it goes from feeling as though it contains fluid, in the period early after an injury, to feeling as though it contains something more like modeling clay, in the later period after injury.

## *Water*

Water associated with muscle tissue exists in several places[23–28,34,39,98,332–340]:

1. Contained in associated vessels such as arteries, veins, or lymphatics
2. In the interstitium, restrained in compartments formed by connective tissue
3. Freely in the interstitium
4. Loosely bonded to the hydrophilic molecules of the connective tissue matrix

Water normally flows relatively freely between these places.[23–28,34,39,98,332–340] Changing a muscle's position from fully shortened to fully lengthened results in increased fluid pressure within the muscle, which causes the muscle to feel harder during palpation. Pathology or injury may also shift water balance towards or away from one location, resulting in palpable changes in resting tension. For example, excess interstitial water may feel soft during the initial stages of edema and lymphedema, or it may feel harder in compartment syndromes when pressure builds as a result of the water restrained behind the thick fasciae. Some therapists believe that it is also possible to identify when the matrix is less hydrated through palpation.

## *Connective Tissue*

Fascia contributes to a varying proportion of the firmness of muscles at rest, as assessed by palpation.[23–28,34,39,98,332–340] This firmness is the result of two components: collagen fibers and the connective tissue matrix in which the collagen fibers are embedded. Poor modeling of the connective tissue within the muscle is one of several processes that

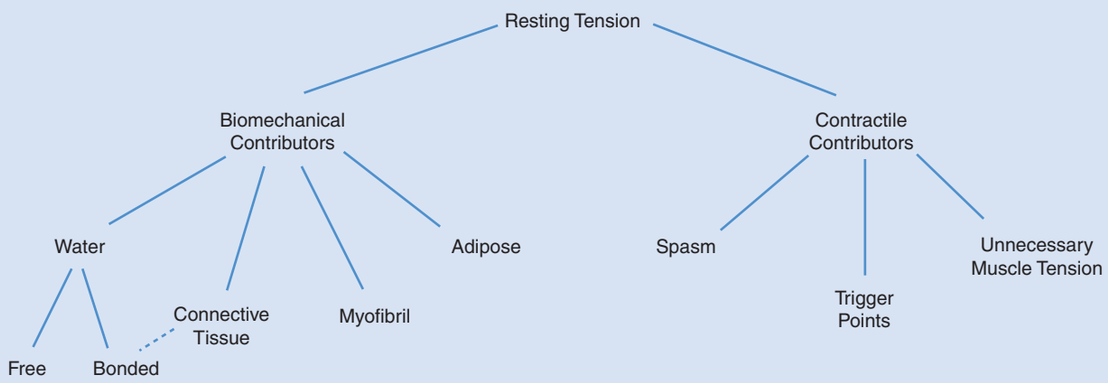


**Figure 5-6** Components of muscle resting tension. (Adapted from Mense S, Simon DG. *Muscle Pain: Understanding Its Nature, Diagnosis, and Treatment.* Philadelphia: Lippincott Williams & Wilkins; 2001.)

may contribute to the increased resting tension that clinicians palpate in the chronic stages of orthopedic injuries.

### *Other Tissues*

The contractile tissue—myofibrils composed of sarcomeres in series—affords little resistance to pressure when the muscle is not contracting.[23–28,34,39,98,155,332–340] A discussion of the contributions of active contraction to resting tension follows. Muscle also contains variable amounts of embedded fat (the marbling seen in meat), which gives little resistance to pressure during palpation under normal circumstances.

### *Biomechanical Behavior of Muscle as a Whole*

The mechanical behavior of noncontracting muscle is complex.[23–28,34,39,98,155,332–340] A force that clinicians apply quickly to muscle, such as a stretch or digital compression, will produce an initial deformation known as elastic deformation. When they apply the same force slowly, it produces further deformation, called viscous (or plastic) deformation. Furthermore, the amount of deformation of the tissues depends on the rate of application of the force. In addition, muscle tissue shows thixotropy, which means that it becomes more fluid and its stiffness decreases in response to movement. These behaviors depend on a complex interaction between the several components listed earlier that specialized texts discuss in detail.

## Myofibril Contraction Contributions to Resting Tension

The contractile activity of the sarcomeres that make up the myofibril contributes to resting tension.[23–28,34,39,98,155,332–340] Some authors define this as active tone or hypertonicity. This contractile activity is absent in normally innervated healthy muscle tissue. Figure 5-6 shows examples of ways in which contractile activity causes increased resting tension.

### *Unnecessary Muscle Tension*

**Unnecessary muscle tension** refers to "unwitting muscular contraction" or muscle tension that is under voluntary control.[23–28,34,39,98,332–340] Clinically, clinicians commonly see it in clients with muscle tension due to situational stress. Clinicians often observe unnecessary muscle tension in clients who request massage for wellness or to address the effects of stress.

### *Trigger Points*

**Trigger points** involve sarcomere shortening and myofibril activity, possibly as a result of calcium leakage at dysfunctional motor end plates.[23–28,34,39,98,155,332–340] In this situation, motor neuron and EMG activity are absent. The contraction knots and taut bands of trigger points frequently cause elevated resting tension.

### *Spasm*

**Spasm** involves involuntary contractile activity that is associated with motor neuron and EMG activity.[23–28,34,39,98,332–340] Spasm produces pain in one of three ways: by overloading parts of the muscle, by subjecting nociceptors between active and nonactive parts of the muscle to shearing forces, or through ischemia. Spasm is a common result of orthopedic injuries.

## A Vocabulary for Resting Tension

Poorly defined terminology and a lack of clarity on the source of muscle tension hamper the understanding of musculoskeletal pain and of muscle pain in particular.[23–28,34,39,98,155,332–340] Clinicians often develop an informal language for describing states of resting tension in otherwise healthy individuals. Some words such as "hard," "tight," "soft," "wiry," and "ropy" directly describe the texture of the muscle at rest. Expressions like "normally toned," "well-toned," or "hypertonic" make a judgment about function. Descriptors like "boggy," "dry," or "leathery" have unspoken implications about tissue health. Terms like "taut band" or "facilitated segment" link palpatory findings to complex theories about pathology of muscle or other tissue. Clinicians need to use these terms with caution since the literature has not defined them systematically.

# Client Examination for Massage: Advanced Examination Techniques

This section documents advanced examination techniques that are relevant to Outcome-Based Massage.

## MUSCULOSKELETAL EXAMINATION

### Joint Integrity

#### *Definitions and Etiology*

##### Joint Integrity

**Joint integrity** is the extent to which a joint conforms to the expected anatomical and biomechanical norms.[39,141,56–58,224–245]

##### Capsular Restrictions

**Capsular restriction** is anatomical or pathological shortening of the joint capsule.[39,141,56–58,224–245] Capsular restrictions occur as a result of a variety of clinical conditions such as disuse, immobility, venous congestion, and diabetes. "Frozen shoulder" or adhesive capsulitis, for example, is a common capsular lesion seen in rehabilitation. This adherence of the shoulder capsule to the humeral head may be the consequence of altered supporting structures of and around the shoulder or autoimmune, endocrine, or other systemic diseases.

##### Capsular Laxity

**Capsular laxity** is anatomical or pathological lengthening of the joint capsule.[39,141,56–58,224–245] For example, global (anterior, inferior, and posterior) excessive laxity of the glenohumeral joint capsule leads to multidirectional instability of the shoulder.

##### Capsulitis and Synovitis

**Capsulitis and synovitis** describe inflammation of the synovium and the joint capsule and associated internal ligaments.[39,141,56–58,224–245] This can be associated with capsular distention secondary to increased levels of fluid in the joint, for example, as in rheumatoid arthritis.

##### Ligament Insufficiency

**Ligament insufficiency** is anatomical or pathological shortening of the capsular ligament.[39,141,56–58,224–245] For example, anterior capsular ligament length insufficiency in the glenohumeral joint can contribute to altered glenohumeral joint mechanics and shoulder pain.

##### Ligament Laxity

**Ligament laxity** is anatomical or pathological lengthening of the capsular ligament.[39,141,56–58,224–245] Anterior cruciate ligament laxity, for example, is a common cause of knee instability, pain, and functional limitations in athletes.

##### Nonmyofascial Trigger Points

**Nonmyofascial trigger point** is a hyperirritable spot in scars, fascia, periosteum, ligaments, and joint capsules that is associated with a hypersensitive palpable nodule in a taut band.[23,28,39,141,56–58,224–245]

#### *Overview of Examination Techniques*

Cyriax[240] defined "capsular patterns," which are clinical signs of capsular lesions that are demonstrated during selective tissue tension testing that are supported by recent research.[23,28,39,141,56–58,224–245] Selective tissue tension testing involves the performance of a specific sequence of active range of motion, passive range of motion, and resisted isometric testing of the joint in question, during which clinicians observe sequences of pain and limitations of motion. Clinicians can identify clinical conditions with high levels of reliability (kappa = 0.875) using selective tissue tension testing.

The integrity of ligaments is best assessed clinically using a variety of static stability tests that demonstrate the stability of the ligaments of selected joints.[23,28,39,141,56–58,224–245] An example of these tests is the Lachman test of knee collateral ligament stability. Laboratory or instrumented tests of impaired joint integrity include magnetic resonance imaging, arthroscopic examination, arthrography, stress radiography, and ultrasonography.

### Joint Mobility

#### *Definitions and Etiology*

##### Joint Range of Motion

**Joint range of motion** is the capacity of the joint to move within the anatomical or physiological range of motion that is available at that joint based on its arthrokinematics

and the ability of the periarticular connective tissue to deform.[39,155,246–289] Range of motion reflects the function of the contractile, nervous, inert, and bony tissues and the client's willingness to perform a movement.

### Passive Range of Motion:

**Passive range of motion** is the amount of joint motion available when an examiner moves a joint through its anatomical or physiological range, without assistance from the client, while the client is relaxed.[39,155,246–289]

### Active Range of Motion

**Active range of motion** is the amount of joint motion that can be achieved by the client during the performance of unassisted voluntary joint motion.[39,155,246–289]

### Accessory Joint Motion

**Accessory joint motion** is the range of motion within synovial and secondary cartilaginous joints that is not under voluntary control. Consequently, clinicians can only obtain this measure passively.[39,155,246–289] These motions, also known as joint play movements, are essential for full and pain-free active range of motion.

### End Feel

**End feel** is the quality of motion or sensation that clinicians "feel" in the joint during overpressure at the end of passive range of motion.[39,155,246–289]

Impaired joint mobility can be the result of numerous primary impairments such as impaired muscle extensibility, altered muscle tone, capsular restriction or inflammation, tendinopathy, neurological deficit, pain, or bony deformity.[39,155,246–289] For the sake of clarity, this chapter defines relevant impairments in separate sections, although it outlines examination techniques for general range of motion testing here.

## *Overview of Examination Techniques*

Goniometry is the established approach to measuring joint range of motion for peripheral joints, and the universal goniometer is accurate and efficient.[155,246–289] Numerous studies have documented high degrees of intrarater reliability (ICCs of 0.88 to 0.93) and relatively lower levels of interrater reliability (ICCs of 0.80 to 0.85) for the universal goniometric measurements of a variety of upper and lower extremity joints by novice and experienced clinicians. Less sophisticated techniques for range of motion testing include visual estimation of range of motion. The findings from this technique may be more variable for many peripheral joints, regardless of therapists' level of experience, but more reliable in joints, such as the forefoot, that are more difficult to measure with goniometry. A parallelogram goniometer is under investigation and shows good reliability ($r = 0.85$ and $r = 0.87$) for the knee joint. Other techniques for assessing range of motion of peripheral joints include wire tracing for joints of the hand and a gravitational protractor. Two-dimensional and three-dimensional computer-aided motion analyses can provide information on the range of motion of multiple joints in static and dynamic postures, which can be more reliable than goniometry, particularly in complex joints. Although clinicians have traditionally measured joint range of motion with the client's joints uncovered, recent studies have explored measurement of clothed range of motion. In this situation, a computerized 6–degree of freedom electromagnetic tracker may be more accurate than goniometry. Finally, clinicians now use standardized measures of self-reported range of motion such as the Single Assessment Numeric Evaluation method, which asks clients to rate their range of motion as a percentage of normal.

Clinicians have used a variety of tools for the measurement of the range of motion of the spine and pelvis.[155,246–289] Measures of spinal range of motion include the Cervical Range of Motion (CROM) instrument, three-dimensional electromagnetic tracking systems, double inclinometers, electrogoniometers, computer-assisted motion analysis, and the combination of flexible rulers and trigonometric calculations. There are more simplistic measures of spinal range of motion that involve the measurement of various distances using a tape measure. The use of measured distances of the client's fingers to the floor in the testing of spinal range of motion may be the least reproducible approach and also reflects the range of motion of joints other than the spine. Another approach, the Schoeber method of using a tape measure placed on spinal landmarks to evaluate the motion of the spine, may be associated with considerable error. Pelvic range of motion can be difficult to measure. Consequently, clinicians can use devices such as the Palpation Meter, a caliper-inclinometer combination, or basic inclinometry to facilitate accurate measurement.

Clinicians measure accessory, or joint play, movements with the joint in the loose-packed position.[155,246–289] One technique described by Kaltenborn involves the palpation of glide and traction/compression ranges of motion during passive movements and the use of a 6-point grading system as follows: hypomobile (0–2), normal (3), or hypermobile (4–6). Accessory movement testing has shown poor to fair intrarater ($r = 0.75$) and interrater ($r = 0.45$) reliability. Lab-

oratory or instrumented measures of accessory joint motion are now available. For example, clinicians use arthrometers to measure anterior-posterior translation (glide) in the knee joint.

The quality of movement is as important as the quantity of range that is available.[155,246–289] Therefore, clinicians should assess the quality of the movement throughout the range and at the end of the range as they perform passive range of motion. In doing so, they should apply overpressure at the end of the range and note whether the "end feel" is normal (bone-to-bone, soft tissue approximation, or tissue stretch) or abnormal (muscle spasm, hard capsular, soft capsular, bone-to-bone, empty, or springy block) for that joint.

# Muscle Integrity

## *Definitions and Etiology*

### Muscle Integrity

**Muscle integrity** is the extent to which a muscle conforms to the expected anatomical and biomechanical norms.[27–30,39,290–306]

### Muscle Extensibility

**Muscle extensibility** is the ability of the muscle and fascia to deform during the movement of a joint through its anatomical range.[27–30,39,290–306]

### Contracture

**Contracture** is a permanent muscular shortening due to a variety of physiological changes in muscle such as fibrosis or loss of muscular balance.[27–30,39,290–306] Physiological contractures are permanent muscular contractions or shortening that do not involve motor activity. The shortening of involved muscles in Volkman's ischemic contracture, for example, involves prolonged ischemia, myonecrosis, proliferation of fibroblasts, scar contraction, and formation of myotendinous adhesions. Muscle contractures may be associated with muscle imbalances that result from neurological disorders such as the presence of hypertonia in cerebellar lesions. They can also be associated with atrophy and fibrosis, as is the case in Duchenne's muscular dystrophy in which biopsies of contractures in selected muscles show a combination of muscle fiber atrophy with perimysial and endomysial fibrosis.

### Muscle Strain or Tear

**Muscle strain or tear** is a lesion or inflammation of muscle fibers that can occur in response to trauma.[27–30,39,290–306]

### Tendinitis

**Tendinitis** is inflammation of the peritendinous tissues that can occur in response to repetitive mechanical trauma.[27–30,39,290–306]

### Tendinosis

Unlike tendinitis, which is an inflammatory condition, **tendinosis** refers to common overuse tendon conditions with a histopathology that is consistent with a noninflammatory, degenerative condition of unknown etiology.[27–30,39,290–306]

### Myofascial Trigger Point

**Myofascial trigger point** is a hyperirritable spot in skeletal muscle that is associated with a hypersensitive palpable nodule in a taut band.[23–28]

- Active trigger points are painful even when no one is palpating them.[23–28]
- Latent trigger points are not painful in and of themselves unless clinicians are palpating them.[23–28]

## *Overview of Examination Techniques*

Impaired muscle extensibility is measured clinically using stretch tests, defined as passive range of motion tests in which the muscle in question is placed in a stretched position, that have been defined for the given muscle group.[23–28,89–96] Extensibility of the hamstring muscles, for example, can be measured using goniometric measures of passive knee extension with the pelvis stabilized; this test can be reliable ($r = 0.99$) and performed with little associated pelvic motion. The Sit-and-Reach Test is another commonly used measure of hamstring extensibility. It is less accurate than the measurement of hip joint angle in this test position because the Sit-and-Reach Test also appears to reflect spinal mobility and anthropometric factors. Laboratory or instrumented measures of muscle extensibility include the use of force/angle data from isokinetic dynamometers, such as the KinCom to measure muscle extensibility with high levels of reliability (ICC = 0.81 to 0.95) for selected muscle groups, and dynamic ultrasonography.

Tendinopathies, muscle strains, and muscle tears are assessed using the methods of selective tissue tension testing outlined earlier in this chapter.[23–28,89–96] In this case, clinicians are looking for a relatively strong contraction of the muscle, with pain on contraction of the muscle (active movement in one direction), pain on stretch of the muscle (passive movement in the opposite direction), pain on isometric movement, and a possible decrease in range of

motion if there is a gross hematoma. The distinction between tendinous and muscular lesions depends on the location of pain during testing and the results of palpation of tenderness. Clinicians can use magnetic resonance imaging when they require additional diagnostic information.

Impaired muscle integrity will also be associated with impaired muscle performance and pain that other sections describe in detail.[23–28,89–96]

### Theory in Practice 5-6

### Using Palpation for Trigger Points

#### Steps in Performing Palpation for Trigger Points[23–28,89–96]

1. Explain the purpose of palpation and the procedures to be followed to the patient.
2. Ask the patient to inform you when she experiences tenderness, a referral of pain, or tingling or any other symptoms as a result of your palpation.
3. Determine the muscle you will palpate for the presence of trigger points. This may include a review of the patient's reported pain behavior in the subjective examination for references to possible trigger point referral zones. Other potential locations of trigger points include muscles that showed limited range of motion on examination.
4. Ensure that your hands are warm and dry.
5. Position the patient with the muscle you will be examining in approximately two-thirds of its normal stretch position. Refer to *Travell and Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual*[23,28] for the test positions for specific trigger points.
6. Drape the patient appropriately (Chapter 6, Preparation and Positioning for Massage).
7. Ensure that the patient is warm and the muscle you plan to palpate is relaxed.
8. Identify the possible location of the trigger point.
9. Palpate the location of the trigger point using one of the following approaches:
   (a) Flat palpation: Slide your finger or thumb along the taut band in the patient's muscle until the patient reports that you have reached the location of maximum tenderness, which represents the trigger point.
   (b) Pincer palpation: You can use this for muscles that you can lift easily. Grasp the belly of the muscle between your finger and thumb. Squeeze and roll the muscle tissue between your fingers to locate the taut band in the muscle. You can repeat this maneuver along the muscle belly until you locate the trigger point.
   (c) Snapping palpation: Once you locate the taut band using pincer palpation, roll the taut band quickly under your fingers to produce a local twitch response.
10. During palpation determine whether the following are present:
    (a) Taut bands. The fiber direction and the pain referral pattern will enable you to identify the involved muscle.
    (b) Local hardness. The trigger point itself may present as a very small area of focal hardness (palpable nodule) in the taut band. Compress this area against the underlying tissues, and determine whether you reproduce the characteristic pain referral pattern for the trigger point in question.
    (c) Twitch responses. You can palpate twitch responses in superficial muscles.
    (d) Jump sign. A patient may produce a large involuntary contraction and other gross affective signs of pain if you palpate the trigger point too forcefully.
    (e) Generalized hardness. If there are adjacent trigger points in overlapping layers, the practitioner may find it difficult to palpate anything other than a generalized hardness. For example, this commonly occurs between the scapulae.
11. During palpation, have the patient compare the pain you produce by palpating the trigger point to her presenting symptoms. The patient should be able to recognize the pattern of pain referral if the trigger point is the contributing cause of her pain.

## Muscle Performance

### *Definitions and Etiology*

#### Muscle Performance

**Muscle performance** is the muscle's capacity to do work based on its length, tension, and velocity.[27–30,39,226–268,306–331] Neurological stimulus, fuel storage, fuel delivery, and balance, timing, and sequencing of muscle contraction all influence integrated muscle performance.

#### Muscle Strength

**Muscle strength** is the force or torque produced by a muscle or group of muscles to overcome a resistance during a maximum voluntary contraction.[27–30,39,226–268,306–331]

### Muscle Power

**Muscle power** is the work produced by a muscle per unit of time (strength × speed).[27–30,39,226–268,306–331]

### Muscle Endurance

**Muscle endurance** is the muscle's ability to contract, or maintain torque, over a number of contractions or a period of time.[27–30,39,226–268,306–331] Conversely, fatigue is a muscle's inability to maintain torque or the loss of power over time.

Because of the multiple inputs required for integrated muscle performance, impaired muscle performance can be the result of adhesions, impaired muscle integrity, abnormal neuromuscular tone, impaired joint mobility, impaired joint integrity, swelling, impaired connective tissue integrity, pain, and postural malalignment, which are described in detail in other sections of this chapter.[27–30,39,226–268,306–331] This chapter does not describe muscle weakness, a primary cause of impaired muscular performance, because massage techniques do not have a direct effect on increasing muscle strength.

## *Overview of Examination Techniques*

Muscle strength can be measured isometrically, isotonically, and isokinetically.[27–30,39,226–268,306–331] The graded manual muscle test is a longstanding clinical approach to isotonic strength testing that has questionable interrater reliability but good intrarater reliability (r = 0.88). Other options for isotonic testing include the one-repetition maximum test. Hand-held dynamometers are an accurate and reliable means of measuring isometric muscle strength and have become the mainstay of clinical practice. Clinicians typically perform hand strength testing with the grip strength dynamometer, the modified sphygmomanometer, and the pinch meter. They can measure isokinetic strength in a variety of ways using isokinetic dynamometers such as peak torque, mean peak torque, and force–frequency relationship. Muscle power is described in terms of peak power, mean power, instantaneous power, and torque–velocity relationships achieved through isokinetic testing. Isoinertial devices produce constant resistance to a movement that enables clinicians to measure isoinertial performance, particularly in trunk muscle testing.

Muscle endurance can be assessed using simple clinical measures, such as the number of repetitions performed, the single-leg hopping test, or more complex tests that include endurance time to limit of endurance and mean power frequency derived from an electromyogram.[27–30,39,226–268,306–331] The client's perceived rate of exertion can be measured using rate of perceived effort tests, such as the Borg Perceived Effort Test, and correlated with objective measures of fatigue.

Clients with certain clinical conditions may require modifications to the usual muscle performance testing measures.[27–30,39,226–268,306–331] The modified sphygmomanometer is a reliable means (ICCs for interrater reliability of up to 0.85) of assessing isometric strength, particularly in geriatric clients and those with rheumatoid arthritis. Clinicians can also use pedaling activities to measure mechanical work and joint power generation patterns in clients who have had cerebrovascular accidents.

Clinicians can also assess the impact of an individual's muscle performance on his ability to perform functional tasks.[27–30,39,188,189,226–268,306–331] The Sit-to-Stand Test, for example, shows the impact of lower extremity strength on the client's ability to perform a functional transfer. The functional capacity evaluations used in occupational medicine measure a client's ability to perform work-related tasks such as pulling, lifting, carrying, and handling weights that reflect muscle performance. Kinematic and kinetic gait analysis using two- or three-dimensional computer-assisted motion analysis and force analysis show the impact of muscle performance on gait.

# Muscle Resting Tension

## *Definitions and Etiology*

### Muscle Resting Tension

**Muscle resting tension** is the firmness to palpation at rest observed in muscles with normal innervation or the perceived texture of muscle during palpation.[23–28,34,39,98,332–340]

### Muscle Spasm

**Muscle spasm** is involuntary contraction of a muscle that results in increased muscular tension and shortness that cannot be released voluntarily.[23–28,34,39,98,332–340] Research suggests that increased excitability of alpha-motor neuron pools contributes to the occurrence of muscle spasm.

## *Overview of Examination Techniques*

Clinicians can assess muscle resting tension and muscle spasm using a variety of tests. Nevertheless, research suggests that palpation is still the most important and exact method for measuring spasm.[23–28,34,39,98,332–340] The other tests for muscle spasm include the tissue compliance meter,

which measures the consistency of soft tissue, badismography, continuous electromyogram, and thermography.

# MULTISYSTEM EXAMINATION

## Pain

### *Definitions and Etiology*

See Pain in the Client Examination for Massage: Foundations section of this chapter.

### *Overview of Examination Techniques*

#### The Pain Interview

Pain is a subjective experience. Consequently, the pain interview is an important means of eliciting information on the different components of the client's experience of pain, such as pain intensity, pain location, pain behavior, and the client's response to pain.[27–30,57–98] Through the pain interview, clinicians can determine the nature of the client's symptoms and the behavior of the client's symptoms over a 24-hour period. General guidelines for a pain interview appear in this chapter. Clinicians should modify the number of issues they cover in the pain interview based on the clinical setting and the client's clinical condition. For example, a more detailed pain interview may be appropriate for a client with chronic back pain in an occupational medicine clinic than it would be for a client with an acute episode of shoulder pain. Readers can refer to the texts on client examination for their health care profession to locate guidelines on issues related to pain assessment for specific clinical conditions. Clinicians can use the information from the pain interview during the Evaluative Phase of clinical decision making to confirm or refute their hypothesis about the client's clinical condition. They can also use the pain interview findings to clarify the impact of the client's pain on his or her functional level and to guide their identification of functional outcomes. The key areas in the pain interview appear in Theory in Practice 5-7: Using the Pain Interview.

#### Measuring Tissue Sensitivity Using a Pressure Algometer or Pain Threshold Meter

Clinicians can use a pain threshold meter or pressure algometer to measure tissue sensitivity to pressure.[23–28,85–96] There are a variety of types of pressure algometers available. Typically, these devices consist of a component for applying pressure, such as a hard rubber tip, attached to a

**Theory in Practice 5-7**

**Using the Pain Interview**

**Location of Pain and 24-Hour Pain Behavior**

Discuss the following issues with the patient as a means of outlining the behavior of the patient's pain over a 24-hour period.[27–30,57–98] Bear in mind that the relevance of these issues will vary with the patient's clinical condition.

(a) Location of symptoms: The patient clarifies any locations marked on the pain drawing that are unclear.
(b) Priority of symptoms: The patient distinguishes between primary and secondary symptoms that she noted on the pain drawing.
(c) Nature of pain: The patient selects a pain identifier, such stabbing or burning, that best describes the pain in a particular location.
(d) Intensity of pain: The patient defines the intensity of pain that has occurred during a specified time period. The practitioner may use a numeric rating scale of 0 to 10, in which 0 represents the absence of pain and 10 represents the most pain the patient has ever experienced.
(e) Additional symptoms: The patient describes associated symptoms, such as paresthesia, that she has noted on the diagram.
(f) Frequency and duration of symptoms: The patient indicates whether pain is constant or intermittent. The patient also indicates how frequently and for how long the symptoms occur. A distinction between the duration of symptoms that occur during the day versus the night may be relevant to the patient's clinical condition. The frequency of the symptoms may be stated as a percentage, such as "50% of waking hours," or in relation to a time of day or an activity, such as "pain starts after 11:00 AM and persists until bedtime" or "burning sensation occurs after 30 minutes of keyboarding."

**Positions That Aggravate Pain**

1. Ask the patient to list the positions, such as sitting or standing, in which she notices an increase in her pain and associated symptoms.
2. For each position, elicit the following information:
   (a) How long can the patient maintain the position before noticing that the symptoms start or before they increase when there is a constant baseline level of pain?
   (b) How long can the patient maintain the position before the symptoms reach a level of intensity that causes her to move out of the position?

(c) When the symptoms change, as a result of being in the position, what is the change in level of intensity of the symptoms? Use the scale of 0 to 10 discussed earlier to show the difference.
(d) What does the patient do to ease her pain and other symptoms once the position aggravates them? For example, note the positions, modalities, exercises, and medications the patient uses to ease pain.
(e) Once the patient has moved out of the position and used some means of pain relief, how much time elapses before the patient notices that the symptoms have returned to the original level?

### Activities That Aggravate Pain

1. Ask the patient to list the activities during which she notices an increase in her pain and associated symptoms. These activities can include:
   (a) Self-care activities such as grooming, feeding, and functional mobility
   (b) Community management activities (instrumental activities of daily living) such as driving, taking the bus, and grocery shopping
   (c) Work-related activities such as lifting, keyboarding, and telephone use
   (d) Leisure activities such as sexual activity, walking, watching television, and playing sports
   (e) Sleeping. Since patients' symptoms are frequently aggravated during sleep, this activity usually warrants additional discussion of issues such as sleep position, bed type, and sleeping behavior.
2. For each activity, elicit the following information:
   (a) What is the time period for which the patient can perform the activity before noticing that the symptoms start (or increase if there is a constant baseline level of pain)?
   (b) What is the time period for which the patient can perform the activity before the symptoms reach a level of intensity that causes her to cease the activity?
   (c) When the symptoms change as a result of performing the activity, what is the change in level of intensity of the symptoms (use a scale of 0 to 10 to show the difference)?
   (d) What does the patient do to ease her pain and other symptoms once performing the activity aggravates then? For example, note the activities, modalities, exercises, and medications the patient uses to ease the pain.
   (e) Once the patient has ceased the activity and used some means of pain relief, how much time elapses before the patient notices that the symptoms have returned to the original level?

### Self-Management

1. Ask the patient to describe the strategies she uses to manage her symptoms. Include details of the frequency, duration, and effects of these activities.
2. Ask the patient if she has received a self-care program in the past. Determine whether she is still performing it. If so, discuss the frequency, duration, and effects of this self-care program.

### Ergonomics

1. Ask the patient to describe and demonstrate the following:
   (a) Usual positions in which she performs her work
   (b) Any repetitive activities that are associated with performance of her job
   (c) Positions that she uses at work that she feels are safe and comfortable
   (d) Positions that she uses at work that she feels cause her pain
   (e) Positions that she uses at work that she feels are adaptations to her pain or that she uses to minimize her pain
2. Ask the patient whether the placement of the furniture and equipment in her work area appears to be contributing to her pain.
3. Ask whether the patient has had an ergonomic evaluation of her work place by a qualified professional. If so, what were the results?

pressure (force) gauge. The dial of the gauge shows pressure readings in $kg/cm^2$ or $lbs/cm^2$. Clinicians obtain pressure sensitivity readings by using the algometer to apply a gradually increasing force on the client's tissues and noting the pressure reading at the time at which the client reports experiencing pain or discomfort. Interrater reliability for pressure algometer scores varies (ICCs of greater than $r = 0.78$ and Pearson correlation coefficients of $r > 0.82$). The pressure algometer is valuable for documenting and reassessing the effects of trigger point therapy and other interventions that change tissue sensitivity because it provides a means of quantifying the client's subjective complaints.

**Theory in Practice 5-8**

**Using a Pressure Algometer to Test Tissue Sensitivity**

1. Stand in a position that will enable you to apply an even pressure to the patient's tissues when the pressure algometer is positioned perpendicular to the patient's skin.[23–28,85–96]
2. Position the patient in a relaxed and well-supported position.
3. Explain the overall procedure to the patient, and demonstrate the application of the pressure algometer on an unaffected area of the patient's body. In particular, instruct the patient to say "Yes" when she first feels discomfort, and explain that you will cease the application of pressure as soon as she does so, so that she does not experience undue discomfort. Explain that rubor and capillary breakage can occur following tissue sensitivity testing with a pressure algometer, and provide basic instructions for the application of ice to the affected areas.
4. Identify the location where you want to test tissue sensitivity. For example, in the case of a trigger point, palpate for a taut band and an area of tenderness in the location specified for that trigger point. Once you have located the area to be tested, you may wish to mark it.
5. Ensure that the pressure gauge is at zero. Place the contact surface of the pressure algometer on the location you wish to test.
6. Hold the pressure algometer so that the shaft of the instrument is at a 90-degree angle to the surface of the patient's skin.
7. Using your free hand, gradually apply pressure on the patient's tissues with the pressure algometer. Continue to increase the pressure gradually until the patient reports feeling discomfort.
8. Cease applying pressure as soon as the patient reports discomfort, and note the pressure algometer reading at that point.
9. Reset the gauge to zero prior to the next episode of testing.

## Impaired Sensation Secondary to Entrapment Neuropathy

### *Definitions and Etiology*

#### Entrapment Neuropathy

**Entrapment neuropathy** is nerve compression that can result from muscle and connective tissue shortening and inflammation associated with trigger point activity, fascial restrictions, overuse syndromes, and other clinical conditions.[27–30,39,70,341–350] The client with an entrapment neuropathy will present with pain, paresthesia, numbness, or loss of range of motion. Common peripheral entrapment neuropathies include carpal tunnel syndrome, cubital tunnel syndrome, and tarsal tunnel syndrome. Less common entrapment neuropathies include posterior interosseous nerve syndrome and anterior interosseous nerve syndrome.

### *Overview of Examination Techniques*

There are a several neurological and musculoskeletal examination techniques that are applicable to assessing entrapment neuropathies.[27–30,39,70,341–350] Dermatome testing includes light touch, hot/cold, pinprick, and filament testing. Myotome testing uses isometric movements and reflexes. In addition, therapists can use sensory discrimination testing (kinesthesia, graphesthesia, and stereognosis), palpation of the nerve in the area of possible compression, vibrometer testing, and neural tension testing.

Electrophysiological testing (nerve conduction studies) evaluates late responses (F waves and H reflexes) and long latency reflexes.[27–30,39,70,341–350] These studies enable clinicians to identify the location and severity of the neuropathy. Electroneurometry (skin surface electrical stimulation of the motor nerve), single-frequency (120-Hz) vibrometry tests, and magnetic resonance imaging are also of value in the diagnosis of entrapment neuropathies.

# NEUROLOGICAL EXAMINATION

## Neuromuscular Tone

### *Definitions and Etiology*

#### Muscle Tone

**Muscle tone** is resting tension and responsiveness of muscles to passive elongation or stretch.[39,332–340,351–376]

#### Postural Tone

**Postural tone** is the development of muscular tension in skeletal muscles that participate in maintaining the positions of different parts of the skeleton.[39,332–340,351–376] The cerebellum regulates postural tone. Unlike muscle resting

tension, constant muscle activation is required for the maintenance of postural tone. Furthermore, the self-sustained firing of motor neurons may reduce the need for prolonged synaptic input.

### Hypertonia

**Hypertonia** is a general term used to refer to muscle tone that is above normal resting levels, regardless of the mechanism for the increase in tone.[39,332–340,351–376]

### Hypotonia or Flaccidity

**Hypotonia**, or flaccidity, is a general term used to refer to muscle tone that is below normal resting levels, regardless of the mechanism for the decrease in tone.[39,332–340,351–376]

### Spasticity

**Spasticity** is increased muscular tone that is a result of an upper motor neuron lesion that may or may not be associated with reflex hyperexcitability.[39,332–340,351–376] Spastic muscle exhibits a velocity-dependent increase in tonic stretch reflexes. The quicker the stretch is, the more pronounced the resistance of the spastic muscle.

### Rigidity

**Rigidity** is increased muscular tone that occurs as a result of brainstem or basal ganglia lesions.[39,332–340,351–376] Rigidity involves a uniformly increased resistance in both agonist and antagonist muscles, resulting in stiff, immovable body parts, independent of the velocity of the stretch stimulus. Patients exhibit two types of rigidity: (1) **cogwheel rigidity**, which is a ratchet-like response to passive movement, alternating between giving way and increased resistance, and (2) **lead pipe rigidity**, which is constant response to passive movement.

- **Decorticate rigidity** occurs as a result of brainstem lesions.[39,332–340,351–376] It presents clinically as sustained contraction and posturing of the trunk and lower limbs in extension and the upper limbs in flexion.
- **Decerebrate rigidity** occurs as a result of brainstem lesions.[39,332–340,351–376] It presents clinically as sustained contraction and posturing of the trunk and lower limbs in extension.
- **Parkinsonian rigidity** occurs as a result of basal ganglia lesions.[39,332–340,351–376] It presents clinically as a tight contraction of both agonist and antagonist muscles throughout the movement (lead pipe rigidity). Clients with Parkinson's disease will eventually present with rigidity.

### Clonus

**Clonus** is a cyclical, spasmodic hyperactivity of antagonistic muscles that occurs at a regular frequency in response to a quick stretch stimulus.[39,332–340,351–376]

## *Overview of Examination Techniques*

The measurement of abnormal muscular tone requires an understanding of neurological lesions.[39,332–340,351–376] Manual passive motion testing and the use of tone grading scales, such as the Ashworth scale, are central to the examination of abnormal tone. The client examination for spasticity can also use the pendulum test (using isokinetic dynamometers or a goniometer), torque/electromyogram curves for ramp and hold or sinusoidal oscillation, or the use of hand-held or isokinetic dynamometers to measure resistance to passive movement.

Some standardized assessments of motor control, such as the Fugl-Meyer assessment and the Montreal Evaluation, include sections on manual testing of muscle tone.[39,332–340,351–376] In addition to manual passive motion testing, spasticity can be evaluated using electrophysiological measures that measure the electrical and mechanical features of hypertonic muscle. These measures include electromyographical testing of reflexes such as the T reflexes, H reflexes, F responses, long-latency stretch reflexes, the tonic vibration reflex, and flexor reflexes. Research suggests, however, that there is a stronger correlation between Ashworth scale scores and spasticity than with laboratory or instrumented tests of reflex activity. Therapists can also test for exaggerated or clonic deep tendon reflexes in hypertonic individuals or absent or decreased reflexes for hypotonic states.

In light of the impact that neurological conditions can have on an individual's functional level, there are numerous functional measures that are used in the client examination.[39,332–340,351–376] These measures are similar in their emphasis on motor recovery and the functional tasks that are most often affected in individuals who have had strokes. They differ, however, in the philosophical principles on which they are based. For example, the measures that reflect neurodevelopmental therapy principles include the Rivermead Motor Assessment Protocol and the Montreal Assessment. The Fugl-Meyer assessment uses Brunnstrom's sequence of motor recovery. The Functional Test for the Hemiparetic Upper Extremity is based on both Brunnstrom and neurodevelopmental therapy principles. The structure of other measures, such as the Motor Assessment Scale, the Physical Assessment for

Stroke Patients, and the Arm Function Test, is not based on either philosophy.

# CARDIOPULMONARY EXAMINATION

## Airway Clearance

### *Definitions and Etiology*

#### Airway Clearance

**Airway clearance** is the ability to move pulmonary secretions effectively through the use of normal mechanisms of cough and the mucociliary escalator.[39,167–187]

#### Chronic Obstructive Pulmonary Disease

**Chronic obstructive pulmonary disease** is a pulmonary disorder characterized by the presence of increased airway resistance.[39,167–187] These disorders are associated with increased sputum production and cough that can predispose the individual to recurrent bronchial infection. Examples of chronic obstructive pulmonary disease include emphysema, chronic bronchitis, and asthma.

#### Chronic Restrictive Pulmonary Disease

**Chronic restrictive pulmonary disease** is a pulmonary disorder characterized by the restriction of lung expansion, such as interstitial fibrosis.[39,167–187]

### *Overview of Examination Techniques*

Clinicians base the clinical examination of impaired airway clearance on a number of clinical signs and symptoms.[39,167–187] The Respiratory Nursing Diagnosis Scale (RNDS), which defines major and minor characteristics of impaired airway clearance, summarizes many of these clinical signs and symptoms. According to this scale, the most important characteristic of impaired airway clearance is an ineffective cough. The minor characteristics include tenacious sputum; subjective complaints of inability to cough up secretions; increased or copious sputum; absent, decreased, or abnormal breath sounds; air hunger; abnormal respiratory pattern; nasal flaring; anxiety; dyspnea at rest; cyanosis or other change in color; and restlessness. Characteristics deemed less relevant to impaired airway clearance include asymmetric chest excursion, abnormal inspiratory-to-expiratory ratio, dyspnea on exertion, diaphoresis, and pain.

A number of clinical tests collect the data on which to base the identification of impaired airway clearance.[39,167–187] Visual inspection of cough, visual inspection of the volume and quality of sputum, respiration rate and pattern, color, and accessory muscle use are essential starting points. Pulse oximeters measure oxygen saturation, which is the degree to which arterial blood is oxygenated. Unfortunately, the reliability of this measure decreases when clients' skin has a darker pigmentation. Breath sounds and heart rate are assessed using auscultation. Finally, clinicians can use self-report measures to elicit a client's perception of breathlessness (measured on a visual analog scale), rating of dyspnea on a Dyspnea Rating Scale, or perceived exertion on a Perceived Exertion Rating Scale.

There are several laboratory tests of symptoms associated with impaired airway clearance.[39,167–187] Arterial blood gases show oxygenation, acidosis, alkalosis, compensatory mechanisms, and buffer systems. Pulmonary function tests show inspired volume, respiratory exchange ratio, forced expiratory volumes, inspiratory capacity, and vital capacity. In addition, there are a variety of measures of oxygen consumption. Finally, laboratory measures of actual particle clearance rates are not yet appropriate for use with humans, although they are common in animal research.

A variety of self-report functional measures, such as the Nottingham Health Profile for quality of life and the Self-Efficacy for Functional Activities questionnaire, measure the client's perception of the impact of impaired airway clearance and chronic respiratory disease on his or her functional level and quality of life.[39,167–187]

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