

Review of Integrated Neuromusculoskeletal Release and the Novel Application of a Segmental Anterior/Posterior Approach in the Thoracic, Lumbar, and Sacral Regions

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Integrated neuromusculoskeletal release (INR) using a segmental anterior/posterior approach is an osteopathic manipulative treatment technique that is easily learned and applied. The segmental anterior/posterior approach to INR was developed as a practical osteopathic manipulative treatment procedure for the inpatient setting, but also has equal efficacy in the outpatient setting. It builds on the principles of INR and myofascial release techniques, as well as other techniques. This approach focuses on both the anterior and posterior connectivity of the body through the neuromusculoskeletal system and uses this connectivity to effectively treat somatic dysfunctions. The principles of INR are discussed, as well as the role of INR in the diagnosis and treatment of somatic dysfunctions in the thoracic, lumbar, and sacral regions.

Integrated neuromusculoskeletal release (INR) is an osteopathic manipulative treatment (OMT) technique that has been formalized by Robert C. Ward, DO. According to Ward, "Integrated neuromusculoskeletal release and myofascial release ideas have been a part of American osteopathic thinking from early in the profession's history. Until recently, they were commonly referred to as isometric-isotonic, fascial release, and functional techniques."^{1(p843)} Ward goes on to define INR and myofascial release as "'combined procedures' designed to stretch and reflexly release patterned soft tissue and joint-related restrictions. Both direct and indirect methods are used interactively."^{1(p843)}

The segmental anterior/posterior (SAP) approach to INR is a time-efficient OMT technique that can be used anywhere at any time. The SAP approach to INR does not require a treatment table, and it is the author's experience on hundreds of inpatient and thousands of outpatient encounters that the technique is nontraumatic and well tolerated. This article discusses the application of the SAP approach to INR in the

diagnosis and treatment of the thoracic, lumbar, and sacral regions. A full review of INR techniques is beyond the scope of this article, but it, as well as a variety of OMT techniques (eg, ligamentous articular strain technique, muscle energy technique, facilitated positional release, strain/counterstrain, Still's technique, myofascial release) that similarly focus on the balancing of muscles, fascia, and the nervous system, can be used to address the entire body. It has been the author's experience that a SAP approach to INR can be taught in both clinical and classroom settings. In addition, students have been receptive and recognize its practicality immediately.

Fascia

The whole of OMT has been concerned, purposefully or not, with manipulation of the fascia. However, historically, there were a number of years in the osteopathic profession during which OMT techniques emphasized the joint's role in somatic dysfunction. Yet today, few would argue that even high-velocity low-amplitude OMT techniques do not have a significant myofascial release component.

For the purpose of this article, the starting point for a discussion of fascia will be on its gross anatomy. Jacobs and Falls use the following to describe the gross anatomy and physical characteristics of fascia (*Figure 1*):

Fascia is a derivative of mesoderm. Throughout the body there is a subcutaneous layer of loose connective tissue called the superficial fascia. It contains collagen fibers as well as variable amounts of fat. Superficial fascia increases skin mobility, acts as a thermal insulator, and stores energy for metabolic use. The dense connective tissue envelope that invests and separates individual muscles of the limbs and trunk is deep fascia. It is also composed primarily of collagen fibers.

Between individual muscles there is a fascial plane that represents the separation of the connective tissue investment (wrapper) of the individual muscles. In the limbs and neck deep fascia pass over and between muscle groups and connect to bone periosteum. The deep fascia passing between muscle groups are called intermuscular septa. Together with the deep fascia passing over muscle groups, they serve to compartmentalize muscle groups of similar functions and innervations. Deep fascia between individual muscles that move extensively are loose connective tissue, which facilitate move-

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ment. As connective tissue, fascia provide for mobility and stability of the musculoskeletal system. There is a myofascial continuity throughout the body.

Peripheral nerves, blood, and lymph vessels lie in the loose connective tissue fascia between muscles. This fascia binds together these nerves and vessels, and collectively these components form the neurovascular bundle.^{1(p35)}

Jacobs and Falls also describe the “myofascial continuity” of the body through the example of the tendinous attachment of muscle to bone:

The dense fibrous connective tissue is anchored to the compact cortical substance of bone by microscopic connective tissue penetrating fibers, Sharpey's fibers. The connective tissue that then forms the mass of the tendon becomes feathered to interdigitate with the skeletal muscle fibers that will form the substance of the muscle.... The connection of tendon to bone provides functional integrity of each part of the body across each synovial joint by way of the muscle tendon complex.^{1(pp41-42)}

Moving on to a more functional description of the fascia, Chila eloquently and succinctly defined its role in structural support, motion, and maintenance of balance:

Fascia of the human body can be described as a sheet of fibrous tissue that envelops the body beneath the skin; it also encloses muscles and groups of muscles, separating their several layers or groups.... In addition to extensive attachment for muscles, the fascia of the human body is provided with sensory nerve endings and is thought to be elastic as well as contractile. Fascia supports and stabilizes, helping to maintain balance. It assists in the production and control of motion and the interrelation of motion of related parts. Many of the body's fascial specializations have postural functions in which stress bands can be demonstrated.^{1(p819)}

To fully understand the diverse role of fascia, it is necessary to explore the neuroanatomy of this structure. According to Beyers and Bonica:

It is clinically important that approximately 20% of cutaneous high-threshold mechanoreceptors supplying the skin also have receptive fields in the subcutaneous tissue, usually the fascia.... The stretch receptors of muscle comprise only approximately 25% of the sensory innervation, and the other 75% consists of free endings in fascia of the muscles, between muscle fibers, and in the walls of blood vessels and tendons. These endings are supplied by thin A-delta myelinated axons (group III) and unmyelinated C fibers (group IV).... A majority of them respond to inflammatory mediators and also to innocuous to noxious pressure and thermal stimuli and are

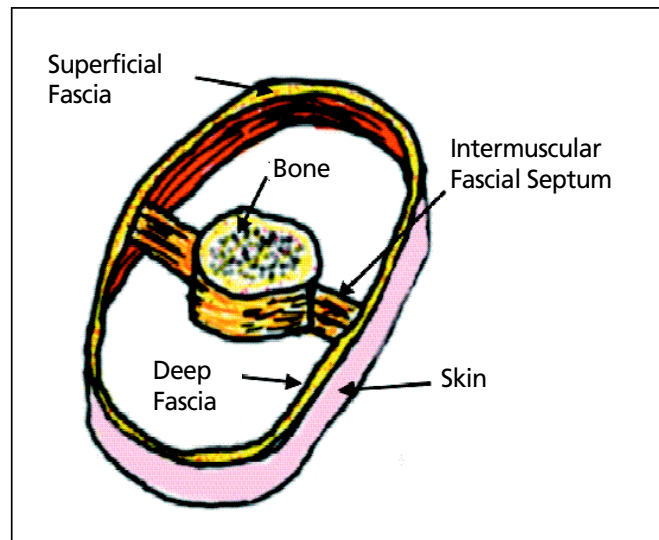


Figure 1. Transverse section through an extremity illustrating the organization of superficial and deep fascia.

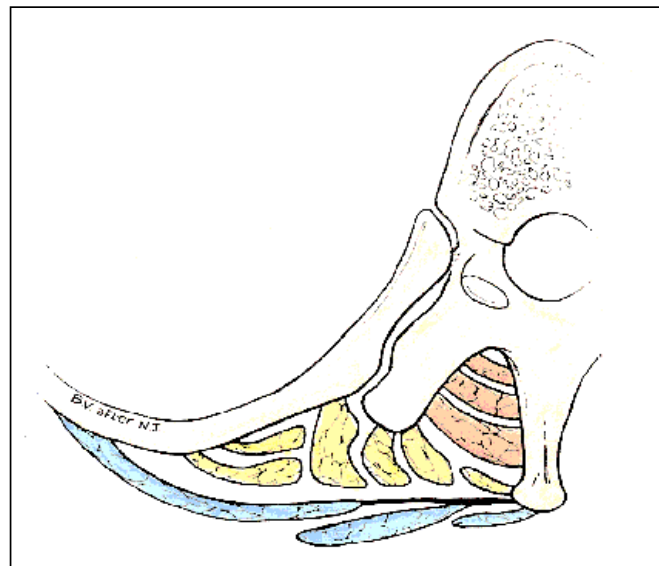


Figure 2. Myofascial layers. The different colors represent muscle layers at different depths (blue, superficial; yellow, intermediate; red, deep). (From Grant's Atlas Images—Complete Collection. Baltimore, Md: Williams & Wilkins; 1998.)

therefore clearly polymodal receptors. They also can be activated by muscle stretch or contraction. Approximately 80% of the C fibers are polymodal, but their threshold to mechanical stimuli is higher than that of the A fibers, their receptive fields are small areas within muscle or tendon, adaptation is slow, and few respond to stretch and none to contraction.²

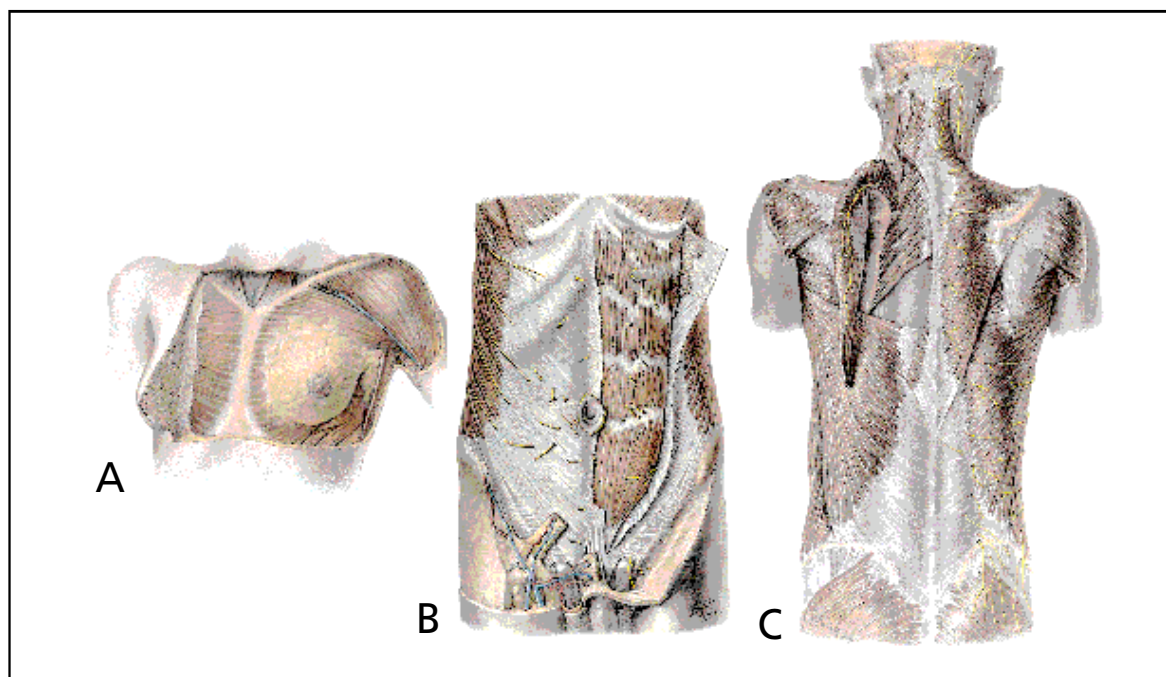


Figure 3. Anterior and posterior fascial attachments. **A**, Myofascial attachments in the thoracic region; **B**, Myofascial attachments in the abdominal region; **C**, Myofascial attachments of the back. (From Grant's Atlas Images—Complete Collection. Baltimore, Md: Williams & Wilkins; 1998.)

As we have established the myofascial continuity of the body, it is important to add that the periosteum, joint capsule, ligaments, joint fat pads, and even blood vessels are innervated with the same polymodal nerve fibers previously described.² Furthermore, the joints are also innervated by “large (group I) and medium (group II) A fibers that terminate in mechanoreceptive endings that detect the torque that develops as a joint is extended, flexed, or rotated to the extreme of its range.”²

For the purpose of this discussion, it is necessary to examine the trunk from a more macroscopic view of the fascia. One observes the tubular nature of the fascia covering an inner core of the spine and organs, and then a progression of layers. For instructional purposes, these muscle groupings have been traditionally divided into the superficial, intermediate, and deep muscles of the body (Figure 2). On the anterior surface of the body, there is a central “tendon” onto which the fascia anchors, and this goes from the symphysis pubis, along the linea alba, and then onto the sternum. Posteriorly, the fascia is anchored from the tailbone to the spinous processes of the vertebrae, and from the nuchal ridge of the cervical spine to the skull (Figure 3).

Muscles

While a discussion of the entire muscular system is beyond the scope of this article, there are properties of these structures

that need to be considered. First, it is important functionally to consider the “tight-loose” concept of INR, which is well elaborated upon by the observations and research of Janda:

Muscle shortness or tightness, which develops without any evident structural neurological lesion and is apparently associated with overuse of the particular muscle, has never been properly defined. It indicates a condition in which the muscle is shorter than normal at rest and cannot be stretched either passively or actively to its normal length. Such a shortened muscle may move the joint from the normal rest position when inactive. It does not allow full range of motion. The important point is that a tight muscle—evidently in keeping with Sherrington's law of reciprocal innervation—inhibits its antagonist counterpart.... (Sherrington's law: When a muscle receives a nerve impulse to contract, its antagonists receive, simultaneously, an impulse to relax.)

The result of decreased muscle flexibility is not only a lower excitability threshold, but also a changed elasticity, evidently due to hypertrophy and retraction of the retractile connective tissue in the muscle. The hypertrophy and retraction unfavorably influences the contractile ability of the muscle fibers. In addition, it may lead to impaired circulation producing ischemia and thus accelerating degeneration. Ultimately, the whole process results in a functional disability.”³

It must be remembered that the “connective tissue” to which Janda refers is fascia, and it is therefore the fascia that is “hypertrophied and retracted with resulting unfavorable

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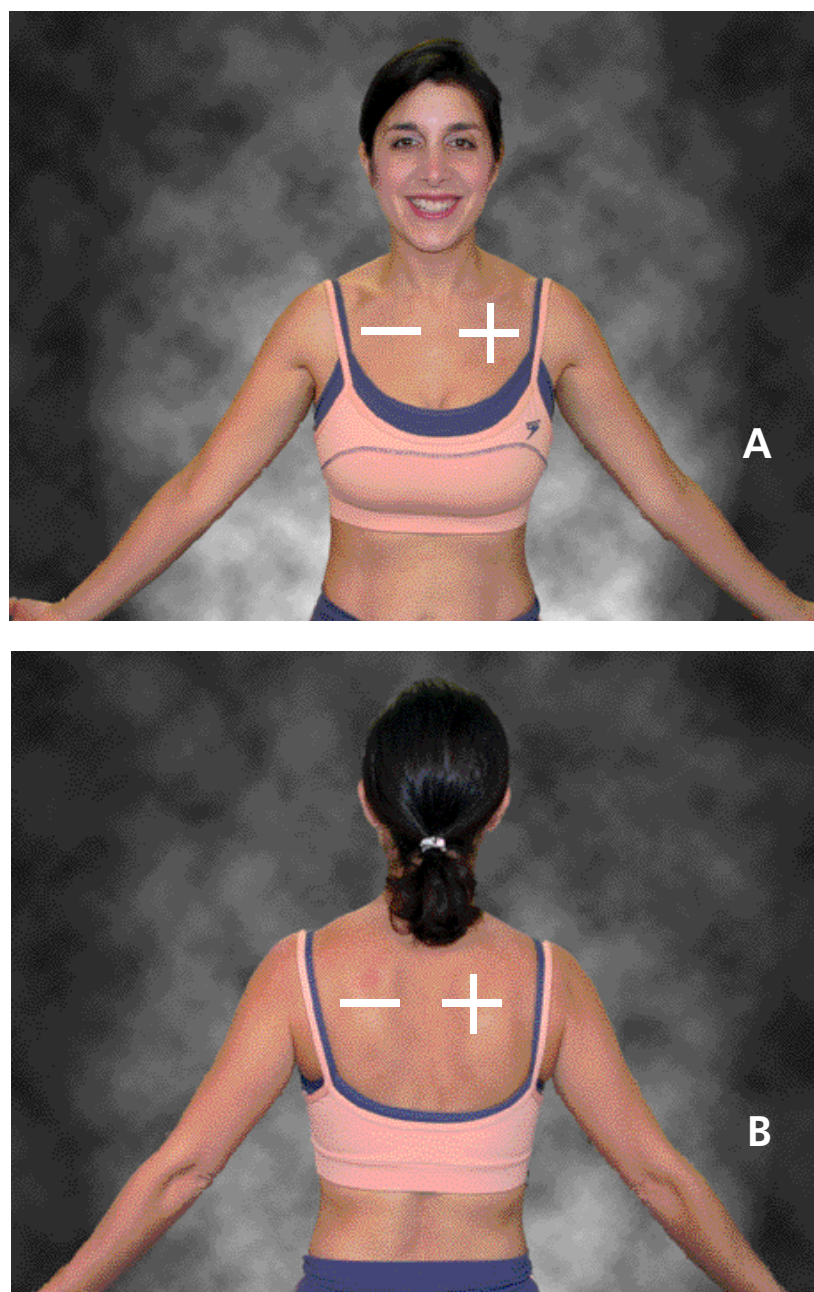


Figure 4. Tight-loose relationship of the thoracic inlet. **A**, Anterior tight-loose relationship; **B**, Posterior tight-loose relationship. Note that the example has an alternating pattern with respect to the right-left relationship and anterior-posterior relationship. + = tight; - = loose.



Figure 5. Screening—posterior hand placement in the thoracic region.

influences upon the muscle fibers.” Ward has similarly and succinctly written: “For every tightness, there is a three-dimensionally related looseness. Commonly, the looseness is in exactly the opposite direction from the tightness.”^{1(p848)}

To continue to develop this concept in more distinctly osteopathic terms, a muscle that is facilitated as the result of a somatic dysfunction (due to direct injury, somatosomatic or viscerosomatic reflexes) will inhibit its antagonist(s). On a broader scale, this tight-loose concept can be extrapolated to explain osteopathic observations like Zink’s common compensatory pattern. Zink and Lawson described the common compensatory pattern based on palpatory and observational findings, like those described in the following excerpt relating to the cervicothoracic junction:

The cervicothoracic curvature rotates the first thoracic vertebra and side-bends it to the right, causing the first rib on the left to be moved anteriorly so that the infraclavicular-parasternal area on the left appears to be “full,” or convex; the first rib on the right is forced posteriorly. Therefore, the infraclavicular-parasternal area on the right seems “hollowed out,” or concave.⁴

Digging deeper, it must be understood that the rotational component of this part of the common compensatory pattern is maintained by a tight-loose relationship of the musculature of this region governed by Sherrington’s law. There is an anterior-to-posterior and side-to-side relationship to the tight-loose phenomenon. For example, if there is tightness at T4 on the posterior right aspect of the body, then there will be looseness on the contralateral posterior side at that level and at the ipsilateral anterior part of the body (Figure 4). There is also a corresponding tightness at the anterior contralateral side of the body. The tight-loose relationship is one of the key concepts used in diagnosis and treatment in INR and will be developed further in the treatment section of this article.

Another characteristic of “tight” muscles is that they tend to develop trigger points. Travell and Simons define a myofascial trigger point as “a hyperirritable spot, usually within a taut band of skeletal muscle or in the muscle’s fascia, that is painful on compression and that can give rise to characteristic referred pain, tenderness, and autonomic phenomena.”^{5(p3)} According to the “integrated hypothesis,” the latest and most feasible theory that explains the nature of trigger points,

It is now becoming clear that the region we are accustomed to calling a trigger point or a tender nodule is a cluster of numerous microscopic loci of intense abnormality that are scattered throughout the nodule. The trigger point is like a nest of hornets that contains multiple minute sources of intense trouble. The critical trigger point abnormality now appears to be a neuromuscular dysfunction at the motor endplate of an extrafusal skeletal muscle fiber, in which case the myofascial pain caused by trigger points would be a neuromuscular disease.^{5(p57)}

Treatment of trigger points is by trigger point injection, the application of a coolant followed by stretch or the use of postisometric relaxation (also known as muscle energy technique).^{4,5(pp150-173)} As a result of its role as a mixed technique, when used in a direct manner, integrated neuromusculoskeletal release can also be thought of as a muscle energy technique applied directly to the myofascial system. In other words, the myofasciae is put into a position of stretch to the barrier, the patient is instructed to perform a muscular contraction, and on completing the contraction a new barrier can be established. Consequently, INR can be used to treat trigger points and to decrease the myofascial conditions that result in trigger point formation. Furthermore, INR, by virtue of its release of myofascial restrictions, can have a direct role in addressing the compensatory patterns of Zink discussed earlier.

Treatment Considerations

Viscoelasticity is a characteristic of the fascia that means it will deform in relation to the amount of force that is placed on it⁶ through twisting, compression, or stretching. The viscoelasticity

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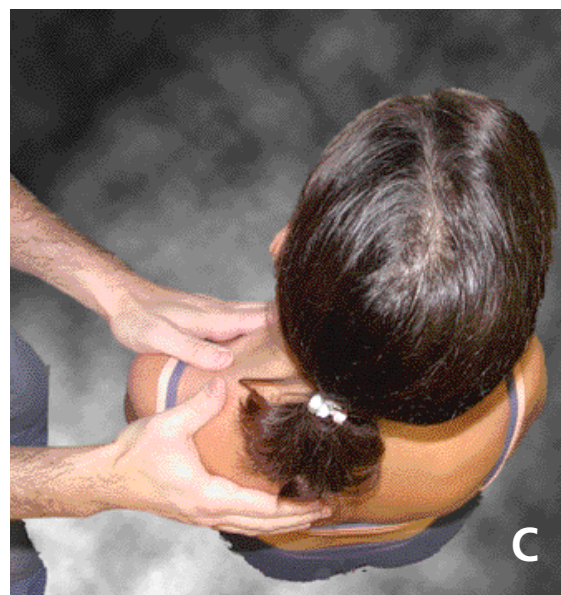
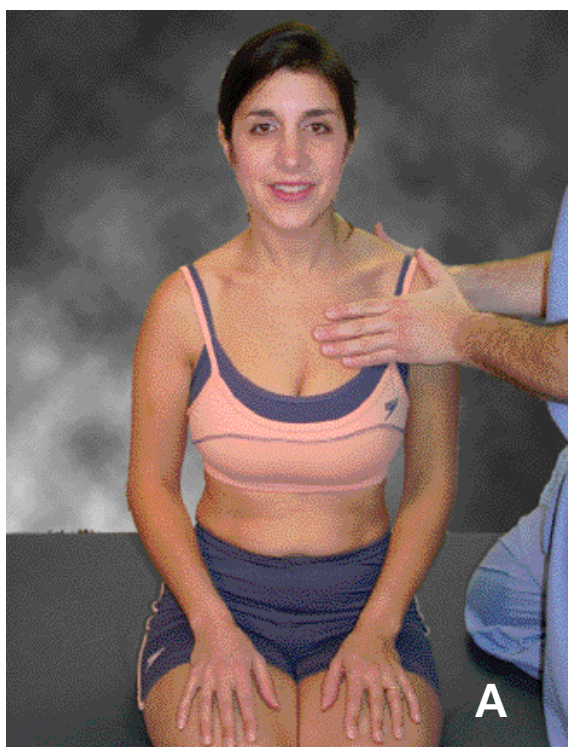
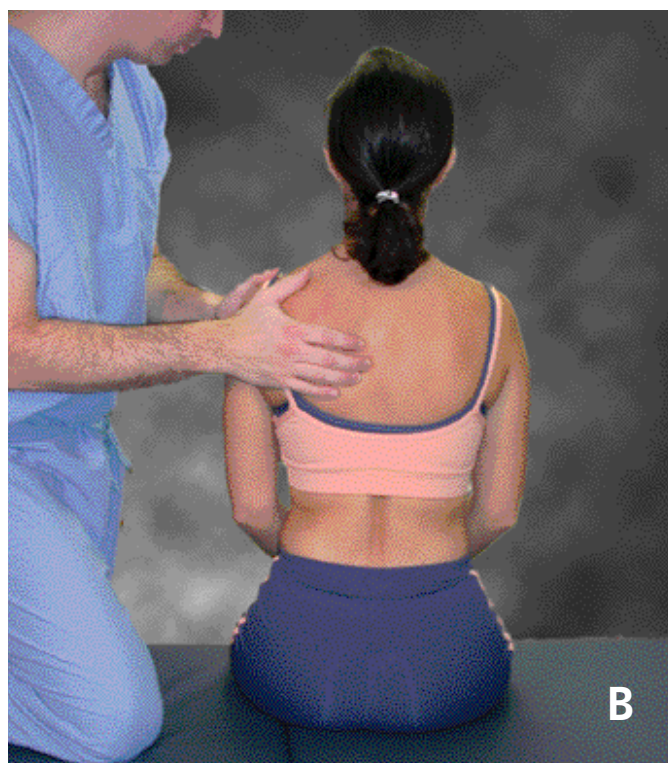


Figure 6. Segmental definition in the thoracic region. **A**, Anterior hand placement; **B**, Posterior hand placement; **C**, Hand placement as seen from above.



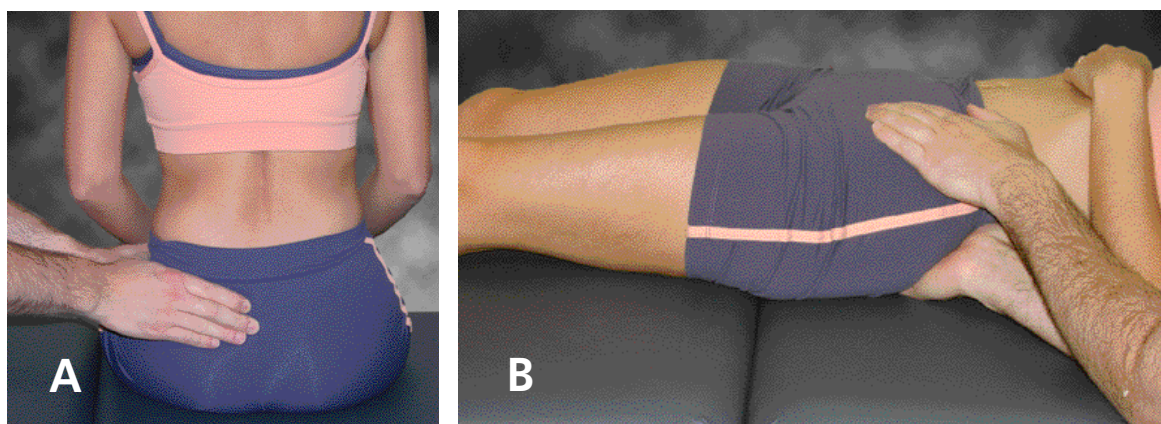


Figure 7. Segmental definition hand placement in the lumbosacral region. **A**, Posterior hand placement; **B**, Anterior hand placement.

of fascia is one of the characteristics that make it treatable. Wolff's law essentially states that fascia will deform as a result of the lines of force to which it has been subjected.⁶ An example of Wolff's law is found among certain cadavers who, previous to passing, had chronically held tension in their shoulders. It has been observed in these specimens on dissection that thicker fascia is found in the region of the muscles that elevate the shoulders. Hence, the fascia had developed and deformed along the lines of stress in that area, and consequently reinforced a maladaptive pattern. By applying direct myofascial release maneuvers (eg, the SAP approach to INR) to these areas of tightness, these maladaptive patterns are released.^{1(p848)}

Segmental Anterior/Posterior Approach to Integrated Neuromusculoskeletal Release Technique

General Considerations and the Screening Examination

There are many osteopathic musculoskeletal screening examinations that are useful in a variety of situations. The one presented in this article is chosen because of its ease of application and its foundation in skills taught at all colleges of osteopathic medicine. However, physicians are encouraged to screen for somatic dysfunction in whichever way they find most comfortable.

It is important to note that although segmental definition and treatment are presented in this article in separate sections, they are usually performed simultaneously at each level, ie, after segmental definition has been achieved, that segment is treated without moving on to define another segment.

Because there is an anterior and posterior hand placement, care is taken with the "anterior" hand not to place it in any position that could be misconstrued as having sexual overtones, for obvious reasons. This is usually not a problem if the examination starts in the sacral area and progresses cephalad. Enough lumbosacral restrictions are usually in need

of treatment so that the patient has grown comfortable with the physician's hand placements by the time the treatment progresses to the thoracic area.

By placing the pads of the fingers medial to the transverse processes of the vertebral column or the sacroiliac region and using an anterolateral pressure and fascial drag, it is possible to identify almost every attribute of the somatic dysfunction. This includes tissue texture abnormality, asymmetry, restricted range of motion, and tenderness. A somatic dysfunction that is not tender on the posterior aspect at a level where tissue texture abnormality and restricted motion are present will be tender on the anterior aspect at that level.

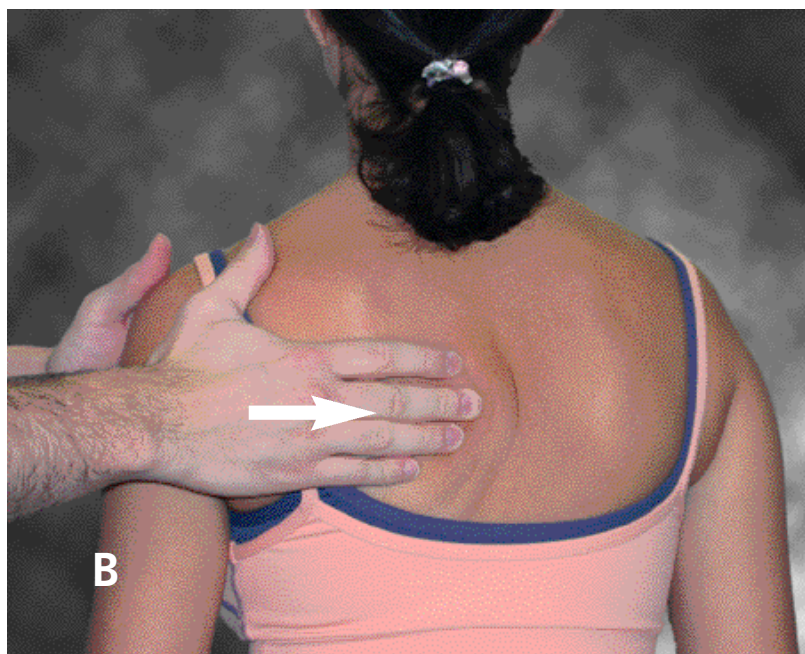
Screening for myofascial tension can be done with the patient in virtually any position, but we will discuss the supine, bed-ridden, hospitalized patient for our intended purpose. The first step is to slide the hand(s) between the bed and the patient so that the pads of the physician's fingers are resting in the recess lateral to the spinous processes and medial to the muscle mass of the erectorspinae muscles (Figure 5) on the same side at which the physician is sitting or standing. This is followed by a lateral pull on the tissues and a partial flexing of the outstretched fingers so that the pads move anteriorly. Tissues that are not tight, tethered, or restricted will move freely, and the transverse processes will rotate away from the finger pads as a result of the gentle anterior pressure. Somatic dysfunctions that are rotated to the side of the physician's fingers will resist rotation and will be stiff.

Segmental Definition in the Thoracolumbar and Sacral Regions

Tissue Tension—To further segmentally define the somatic dysfunction, the physician places one hand anteriorly at the same level as the "posterior" hand that is on the somatic dysfunction. Passive motion testing is done when the physician perceives that the pads of his fingers have sunk into the appropriate tissue layer that encompasses the whole of the restric-

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Figure 8. Segmental definition—rotation to the left. **A**, Anterior hand takes the tissue laterally; **B**, Posterior hand takes the tissue medially.



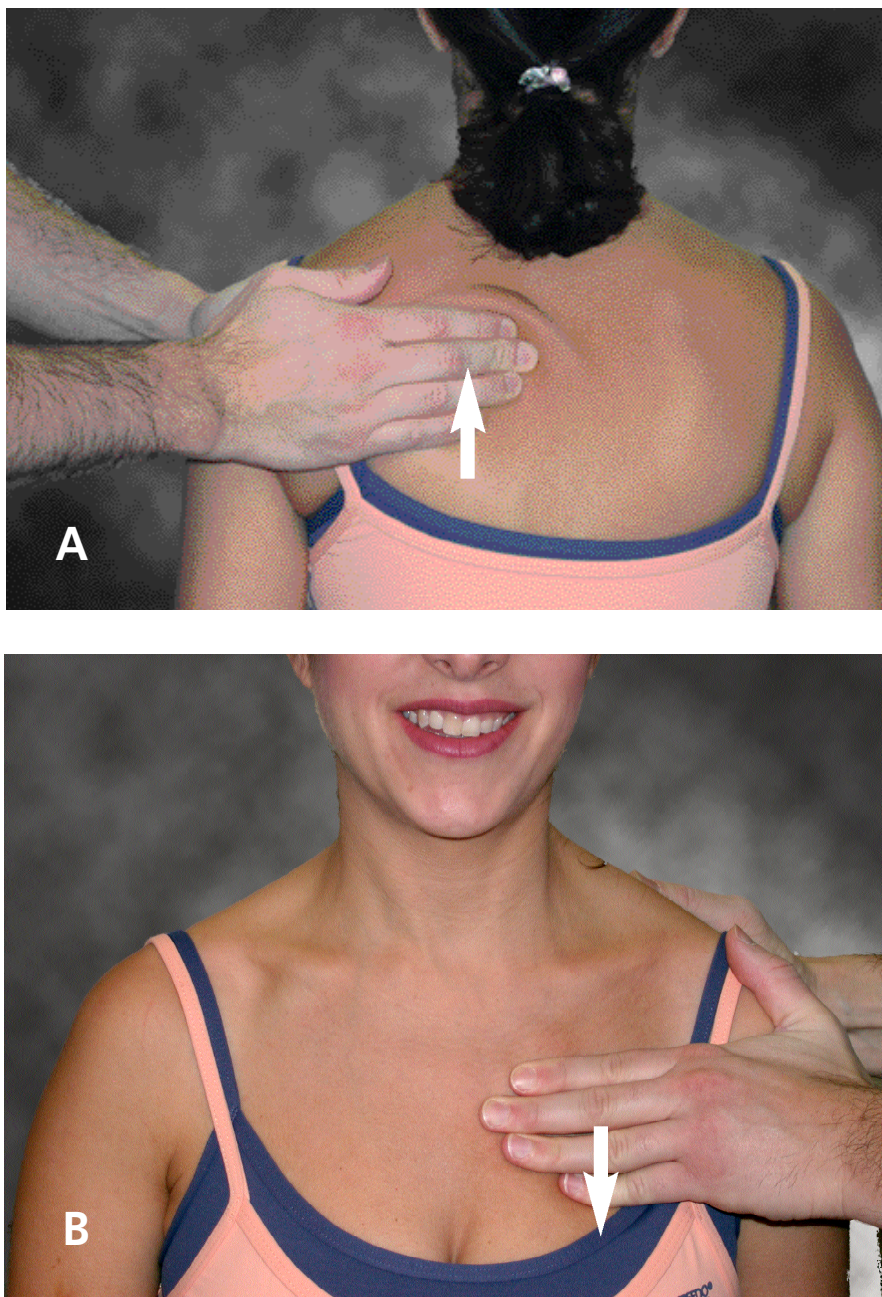


Figure 9. Segmental definition—flexion. **A,** Posterior hand takes the tissue cephalad; **B,** Anterior hand takes the tissue caudad.

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Figure 10. Segmental definition—*inhalation*. **A**, Posterior hand takes the tissue clockwise; **B**, Anterior hand takes the tissue counterclockwise.

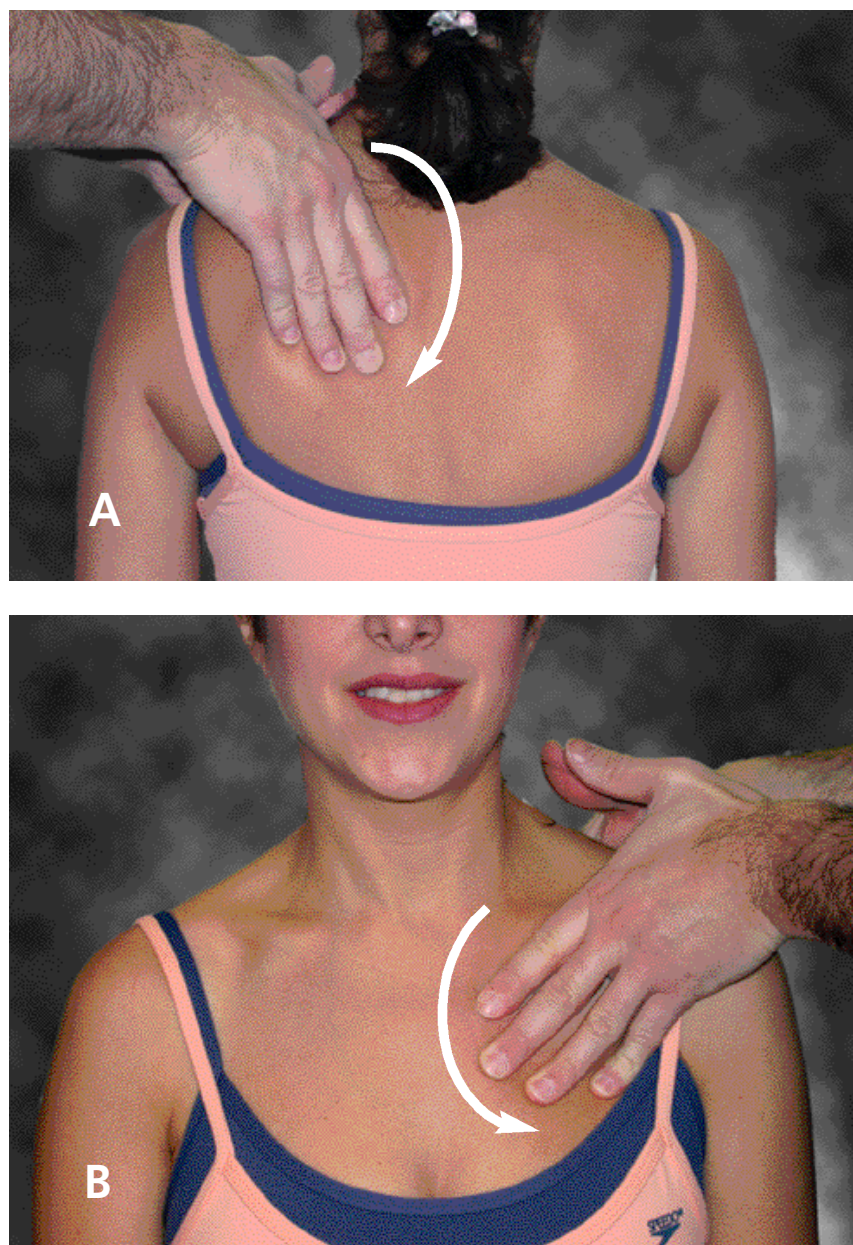




Figure 11. Treatment—thoracic region with the “hula” maneuver. The physician applies a constant force in the cumulative direction of all the resistances examined while the patients moves his or her arms to the right (A) and to the left (B), as if dancing the hula.



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Figure 12. Treatment—thoracic region with the “touchdown” maneuver. The physician applies a constant force in the cumulative direction of all the resistances examined while the patient raises his or her arms as if signaling a touchdown in a football game. This may be accompanied by a deep inhalation on raising the arms and exhalation on lowering them.

tion. The pads of the physician’s fingers remain in place posteriorly between the patient’s transverse and spinous processes. The pads of the physician’s anterior and posterior fingers are placed at corresponding areas, as if a perpendicular rod existed between the finger pads of the physician’s two hands (Figure 6). In the sacroiliac region, the physician’s posterior hand placement will be slightly medial to the sacroiliac joint, and the physician’s anterior hand placement will be medial to the anterior border of the iliac bone (Figure 7).

Rotation, Flexion, and Extension—Once the desired level of the tissue is reached, the physician places the posterior portion under a medial stretch and the anterior portion under a lateral stretch. This, in effect, causes myofascial rotation toward the physician (Figure 8). The stretch is then applied in the opposite directions (anterior hand going medially and the posterior hand going laterally, causing rotation away from the physician). Rotation will be myofascially restricted in one direction or the other.

To define *flexion* using the SAP approach to INR, the

physician introduces a cephalad stretch posteriorly and a caudad stretch anteriorly. Moving the posterior hand caudad and the anterior hand cephalad causes “extension” at that level. Relatively freer motion in flexion versus extension indicates that the segment is myofascially flexed (Figure 9). Relatively freer motion in extension versus flexion indicates that the segment is myofascially extended.

Clockwise and Counterclockwise Testing—At the level of the involved thoracic vertebra, a clockwise and counterclockwise rotation can be used to identify rib involvement that is restricted in inhalation, exhalation, or torsion. Keeping the physician’s hands at the same level, the posterior hand is moved clockwise as the anterior hand is moved counterclockwise to test exhalation on the right and inhalation on the left (Figure 10). Rotating the anterior hand in a clockwise direction and the posterior hand in a clockwise direction introduces torsion. This is compared with counterclockwise rotation of the anterior hand and counterclockwise rotation of the posterior hand (torsion in the opposite direction).

In the lumbar region, the clockwise and counterclockwise testing has more to do with sidebending. Keeping the physician’s hands at the same level, the posterior hand is moved clockwise as the anterior hand is moved counterclockwise to test sidebending toward one direction. Reversing the direction of the rotation of the hands tests sidebending in the opposite direction.

Specifics of Treatment Using the SAP Approach to INR

Treatment of the thoracolumbar and sacral regions using the SAP approach to INR can be done in a direct or indirect manner. When first learning INR, it is easiest to start with a direct technique. The reason for this is that the direct barrier is often easiest to feel and monitor for myofascial release.

For example, in the thoracic region, if a tissue texture abnormality is identified at the level of T4 on the left and range of motion is restricted when the posterior hand stretches the fascia cephalad, medial, and with a counterclockwise rotation while the anterior hand senses restriction when the fascia is stretched caudad, lateral, and in a clockwise rotation, then T4 may be said to be ERS (extended, rotated, and side-bent) right. Furthermore, the fourth rib will probably resist inhalation. Once the myofascial barrier has been engaged in all of these directions, the physician can have the patient do release-enhancing maneuvers to encourage the myofascial release. In the thoracic and upper lumbar regions, this is done using the “hula” maneuver. To do this, patients move their arms to the right and then the left, much the way a hula dancer would (Figure 11). Raising the arms over the head with a “touchdown” maneuver can encourage the extension release (Figure 12), and the return of the arms to anatomic neutral enhances the flexion release. The patient’s respiration can also be used to encourage a release. Combination of the touchdown maneuver with a deep inhalation as the arms

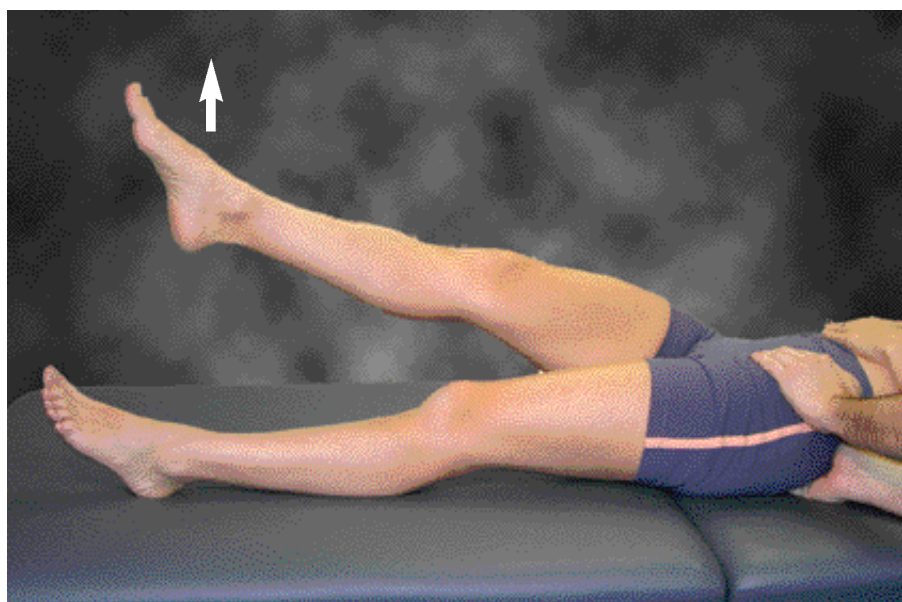


Figure 13. Treatment—lumbosacral region with alternating leg raise. The physician applies a constant force in the cumulative direction of all the resistances examined while the patient raises his or her legs in alternating fashion.

are raised over the head, followed by a complete exhalation as the arms are brought back into neutral position, is one method of combining release-enhancing maneuvers to maximize time efficiency and myofascial release benefits to the patient.

Treatment with the SAP approach to INR in the lumbar region, for example, might find resistance of the tissues to range of motion at L5 on the left when the posterior hand stretches the fascia cephalad, medially, and in a counter-clockwise rotation while the anterior hand stretches the fascia caudad, laterally, and in clockwise rotation. Then, L5 may be said to be ERS right. The patient does the release-enhancing maneuvers by raising each leg one at a time in an alternating manner (Figure 13). Alternatively, the legs may be pressed into the treatment table or bed one at a time in an alternating manner. The method of release enhancement is chosen based on the patient's ability to do the maneuvers, as well as the position of the patient.

Occasionally, a patient is unable to perform the release-enhancing maneuvers due to weakness, pain, or injury. In the case of these limiting factors, the patient is instructed to do them with submaximal effort. Any effort produces neurologic signals (granted an intact spinal cord) that result in muscle fiber contraction and enhance release of the myofascia.

Advantages and Limitations

The advantage of the SAP approach to INR is that it is a time-efficient OMT technique that can be used anywhere at any time to treat somatic dysfunction. Furthermore, the SAP

approach to INR makes a significant contribution to osteopathic manipulative medicine because of its equal focus on the diagnosis and treatment of the anterior and posterior aspects of the body. Based on familiarity with INR and myofascial release techniques, it should be easy to integrate into a physician's repertoire of OMT techniques. It has been the author's experience that a SAP approach to INR can be taught in clinical and classroom settings and that students are receptive to the SAP approach to INR and recognize its practicality immediately.

The two disadvantages to the SAP approach to INR are that it requires attentive palpation and that there may be some posttreatment discomfort. The attentive palpation required to perform the SAP approach to INR, like all osteopathic palpation, should be done, as Sutherland has written, with "thinking" fingers.⁶ For instance, the anterior hand in the lumbar region does not apply the same type of pressure that would be used in palpating the abdomen during a visceral examination. The anterior hand should be tuned to apply only enough pressure to approximate the layer of muscle or fascia that is being treated. If the correct principles are applied, this technique can be extremely useful even in pregnant or postoperative patients. However, novices should probably acquire more experience in using the SAP approach to INR before treating these special cases.

Ward has noted that with an INR treatment, "Patients commonly experience a temporary worsening of discomfort following the first treatment or two. The possibility should

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be identified for them in advance. The phenomenon seems similar to postexercise muscle soreness, though no research has been done on it. Usually the experience occurs only once, but patients with immunologic disorders such as lupus erythematosus and fibromyalgia can experience repeated flare-ups, so one must be cautious.” However, posttreatment discomfort is the exception and not the rule with the SAP approach to INR. There are two theories that the author proposes for this difference in posttreatment discomfort: (1) It may be that the specific segmental approach or the anterior/posterior aspect of the approach may result in the patient being closer to a balanced fascial state than the traditional INR treatment and thus require less adaptation and neuromuscular rebalancing. (2) The SAP approach to INR does not result in as powerful of a myofascial release as the traditional INR treatment and can therefore be thought of as a lower-dose application of INR. Either way, there is not much posttreatment discomfort.

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