

Management of Pelvic-Thoracic Influences on Temporomandibular Dysfunction

Ronald J. Hruska, Jr., MPA, PT

The relationship between temporomandibular dysfunction (TMD) and forward head posture (FHP) is well described in the literature.^{9-11, 14, 17, 30} Current literature also addresses relationships of the cervical spine on the masticating structures and the stomatognathic system.^{2, 7-8, 13, 18-19, 22, 28} These relationships are important when assessing a treatment program for the cervical-cranio-mandibular patient. There are authors who have described the importance of postural training for patients with temporomandibular disorders,³¹ but there is little reference or literature on specific approaches in the management of FHP through a muscular-skeletal biomechanical process that alters and corrects the thoracocervical position.

Successful management of an individual with an FHP requires proper identification of muscular weakness as it relates to the frontal plane, knowledge on how to design a specific home exercise program for abdominal oblique development, and acceptance by the patient in fulfilling daily exercises and activities, including abdominal concentric and eccentric activity, without involving muscles of the anterior or lateral cervical areas. Models of physiologic equilibrium have been presented where malocclusion and head posture need to be addressed simultaneously, otherwise balance of the stomatognathic system will be difficult at best.^{24, 26, 32} This discussion does not focus on developmental issues related to FHP, suboccipital induced myofascial

From the Hruska Clinic—Restorative Physical Therapy Services; and the Postural Restoration Institute, Lincoln, Nebraska

pain syndrome, hyoid equilibrium, neuromotor issues of cervical-cranio-mandibular complex, resting vertical dimension of the mandible associated with ideal posture, or FHP influence on masticatory muscular function. Specific muscular biomechanic patterns as they relate to form and function of trunk and cervical rotation and respiration are outlined by addressing frontal, sagittal, and transverse plane issues. Treatment, as it relates to the need for increased thoracopelvic stability, also is discussed.

The relationship of FHP and posterior cranial rotation (PCR) to an anteriorly, forwardly rotated hemipelvis needs to be better understood by dentists and physical therapists. This foundational relationship, cervical-cranio orientation to the thoracopelvic position, has a compensatory and noncompensatory impact on occlusion, myofascial pain patterns, and treatment outcomes and is an important aspect of postural management with patients who have TMD.

OVERVIEW OF THORACOPELVIC MECHANICAL INFLUENCE

To understand fully how pelvis position can influence the mandible, the clinician must address the major compensatory and noncompensatory patterns of the pelvic-lumbar region on the lumbar-thoracic region, the lumbar-thoracic region on the thoracocervical region, the cervical-cranial region on the craniomandibular region, and the craniomandibular region on the mandibular-cervical or hyoid region. In addition to this anatomic understanding, integration of the scapulothoracic joint, the atlanto-occipital joint, the hyoid complex, and the temporomandibular joint would be helpful, because of thoraconeuromuscular function and facilitation influences. The scapula serves as a *sesamoid* bone, centered between muscular force couples that stabilize the neck and shoulder, whereas the mandible and hyoid bones serve as sesamoid bones between the thorax and cranium. The foundation for these force couples to interplay on each other begins at the pelvis.

The pelvis is the part of the trunk inferoposterior to the abdomen and is the area of transition between the trunk and the lower extremities. The pelvis is responsible for the support and function of the perineum, abdominopelvic cavity, and thoracic cavity. Its main functions are to transfer the weight of the upper body from the axial to the lower appendicular skeleton and to withstand compression and other forces resulting from its support of body weight and its provision of attachments for powerful stabilizing muscles. The two hip bones, composed of the ilium, ischium and pubis, the sacrum, and the coccyx make up the pelvis. The oblique plane of the pelvic brim forms an angle of approximately 55° to the horizontal. This plane coincides with the line

joining the sacral promontory to the superior margin of the pubic symphysis. When this angle exceeds 60° , the thoracolumbar-pelvic curvature in the sagittal plane is placed in an above normal lordotic state. This increase in lordosis can lead to spondylolysis or spondylolisthesis in the inferior lumbar region, increase in compensatory superior thoracic kyphosis, and cervical lordosis.

The abdomen connects the thorax to the pelvis. It has a musculo-tendinous wall except posteriorly, where the wall includes the lumbar vertebrae and the intervertebral discs. The abdominal cavity extends superiorly into the osseocartilaginous thoracic rib cage to the fourth intercostal space, inferiorly with the pelvic cavity, and is surrounded by the multilayered abdominal walls. The abdominal pelvic cavity is probably one of the most influential cavities in determining the postural pattern. Keeping the anterior thoracic cavity close to the pelvic cavity through ongoing support and activation of the anterior-lateral abdominal cavity muscles is one of life's greatest biomechanical challenges. Failure to oppose the diaphragm and keep the anterolateral abdominal wall strong leads to thoracolumbar lordosis, which contributes to anterior rib cage elevation, overuse of accessory respiratory muscle, and FHP.

MUSCLES OF THE ANTEROLATERAL ABDOMINAL WALL

There are five muscles in the anterolateral abdominal wall. The external oblique, internal oblique, and transverse abdominal muscles are flat and more responsible for trunk rotation, exhalation, diaphragm opposition upon inhalation and rib cage depression than the vertical abdominal muscles—rectus abdominis and pyramidalis.

The superficial external oblique muscles arise from the middle and lower ribs by muscular slips that interdigitate with those of the serratus anterior and the pectoral muscle. Their fibers pass inferomedially, and, by way of an aponeurosis, blend with fibers of the opposite internal oblique aponeurosis.

The intermediate internal oblique muscles run horizontally obliquely upward superiorly and obliquely downward inferior to the anterior superior iliac spine. It attaches to the tenth, eleventh, and twelfth ribs, linea alba, and pube by the conjoint tendon. The intermediate internal oblique muscle is an important postural muscle in the transverse plane of movement. Fibers of this muscle blend in with the innermost muscle or transverse abdominal muscle and the external oblique muscle, which make it instrumental in moving the pelvis on a secured thorax or the thorax on a secured pelvis. Rotation in the transverse plane, thoraco-abdominal flexion in the sagittal plane, and lateral

flexion with trunk rotation in the frontal plane all are made possible with this muscle. Unilateral weakness of this muscle creates asymmetry of the trunk, anterior rotation of the pelvis on the ipsilateral side, which is referred to as hemi-lordosis, and rotation of the trunk to the contralateral direction. This rotation in return generates hyperactivity of the posterior trunk muscles on the contralateral side in derotational compensation. Overuse of back extensors for derotational activity generates thoracic-cervical rotational demands, substitutional respiratory patterns, PCR, suboccipital compression, and all other manifestations of an FHP. Therefore, to reduce these transverse plane asymmetries, it is important to keep the strength of each group of oblique muscles the same. Otherwise, the compensatory activity of the superficial posterior thoracoappendicular muscles and the anterior thoracoappendicular muscles facilitate an FHP.

MUSCLES OF THE POSTERIOR THORACOAPPENDICULAR WALL

The posterior thoracoappendicular muscles, or extrinsic back muscles, attach the superior appendicular skeleton to the axial skeleton. Without this muscle group the upper limb would not be controlled totally by the trunk or vice versa. There are four posterior thoracoappendicular muscles: the trapezius, latissimus dorsi, levator scapulae, and rhomboids. It is the latissimus dorsi that has the greatest impact on lumbothoracic lordosis, anterior rib elevation, and FHP because this muscle is the widest muscle of the back. It laterally sidebends the body toward the arm or extends, adducts, and medially rotates the arm toward the trunk through its proximal attachment to the spinous processes of the inferior six thoracic vertebrae, thoracolumbar fascia, and iliac crest, and its distal attachment site to the intertubercle groove of the humerus.

Increased thoracolumbar lordosis, secondary to weakness of the anterior lateral abdominal wall, leads to latissimus dorsi shortening and hyperactivity as a humeral internal rotator, because the force couples that are necessary for proper scapulohumeral intrinsic shoulder internal rotation are imbalanced secondary to improper rib cage position and elevated anterior ribs. It is important to keep the latissimus dorsi lengthened through regular stretching while isolated abdominal oblique muscle strengthening occurs (Fig. 1). Without combining the two programs—abdominal strengthening and latissimus dorsi stretching—the abdominal oblique muscles become strong in a long position and the latissimus dorsi becomes strong in a short one, which further promotes anterior elevated ribs, FHP, and suboccipital posterior cranial rotation. Other agonistic rib elevators and thoracic muscles, serratus posterior superior, levator costarum, external intercostals, and

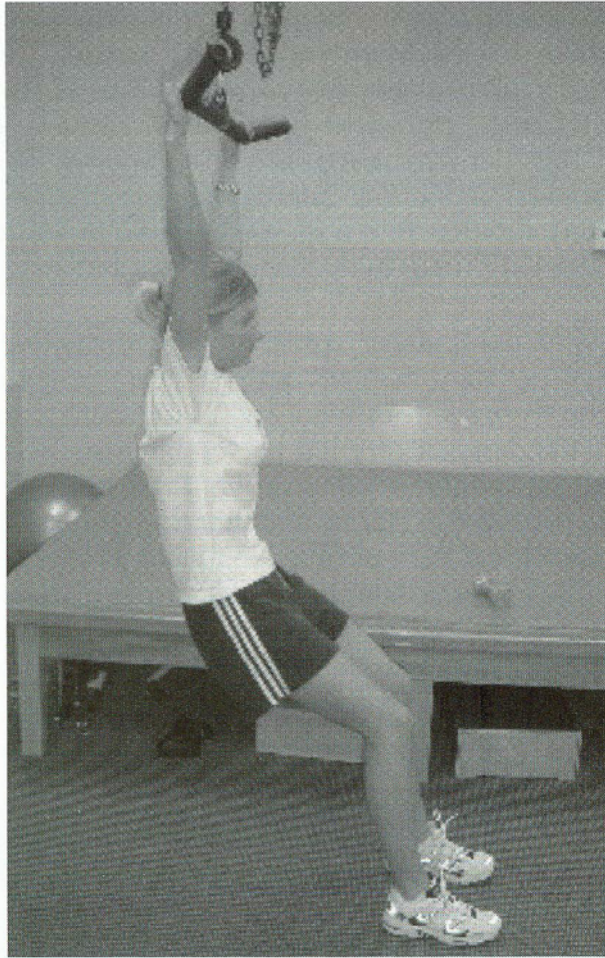


Figure 1 Upright latissimus dorsi hang with maintenance of a posterior pelvic tilt.

subcostals also become shortened. The main force couple of the latissimus dorsi is the pectoralis major. Together, they powerfully adduct the humerus.

MUSCLES OF THE ANTERIOR THORACOAPPENDICULAR WALL

The pectoralis major is one of four muscles that move the pectoral girdle. The pectoralis minor, subclavius, and serratus anterior are important to scapular and upper thoracic stability, but the pectoralis major is the muscle that is needed to challenge an overactive latissimus dorsi. The large fibers of the pectoralis major cover the superior part of the thorax; it has a clavicular and sternocostal head, both of which attach to

the lateral lip of the intertubercular groove of the humerus. The clavicular head attaches to the anterior surface of the medial half of the clavicle. The sternocostal head attaches to the anterior surface of the sternum, superior six costal cartilages, and aponeurosis of external oblique muscle fiber.²³ Together with the ipsilateral abdominal external oblique and the contralateral abdominal internal oblique, the pectoralis major assists with trunk rotation in a transverse plane, in addition to its responsibilities as an adductor in the frontal plane and an extensor in the sagittal plane.

Because hand dominance requires thoracic rotation to the contralateral direction, right-handed activity usually promotes upper thoracic rotation to the left, through right latissimus dorsi, right pectoralis major, and compensatory left pectoralis major activity. Because of associated elevated anterior rib position, these muscles also become short, tight, and overused as sternal and thoracic rotators. It is important to keep these muscles at their normal length simultaneously, therefore, if abdominal oblique strengthening is to be accomplished satisfactorily and symmetric pelvic-thoracic neutrality is to be maintained. Stretching or lengthening these muscles while isolated abdominal oblique muscle strengthening occurs is also important (Fig. 2).

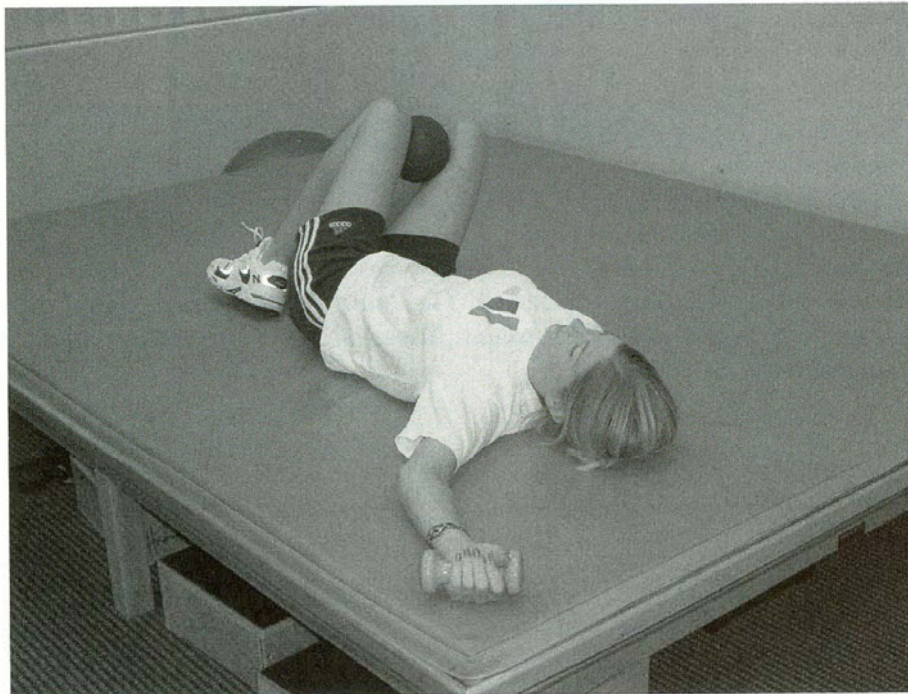


Figure 2 Supine pectoralis major stretch with maintenance of a posterior pelvic tilt.

BIOMECHANICAL IMPLICATIONS OF ELEVATED ANTERIOR RIBS AND AN ANTERIORLY ROTATED PELVIS

If exhalation is difficult at rest, inhalation will be challenging at best. Dyspnea, hyperinflation, paradoxical breathing, diaphragm hypertonicity, and dyssynchronous respiration can occur as a result of improper or unbalanced tension between the diaphragm and abdominal oblique muscles.¹² Mechanical influences of elevated anterior ribs secondary to anterior rotation of the pelvis, as outlined in Figure 3, on pelvic-thoracic and thoracic-upper appendicular musculature of a right appendicular dominant individual can be corrected through specific unilateral abdominal oblique strengthening, latissimus dorsi stretching, and unilateral pectoralis major stretching. Proper muscle strengthening testing of these muscles is required for thorough management of pelvic-thoracic position and cervical-cranio-mandibular balance. Application of stretching and strengthening exercise techniques to both sides of the trunk, however, reduces possible postural asymmetries and

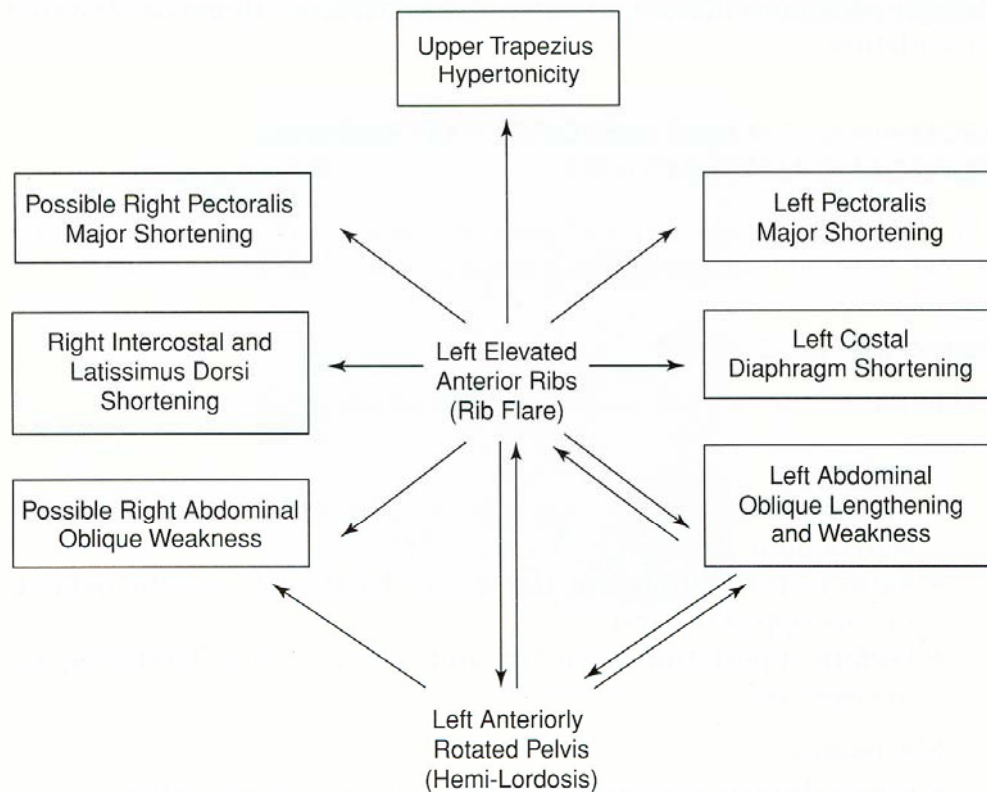


Figure 3 Biomechanical influences on left elevated anterior ribs (left rib flare) and left anteriorly rotated pelvis (left hemi-lordosis) on anterior and posterior thoracoappendicular musculature.

compensatory patterns facilitated by the aforementioned muscles during demanding periods of occupational, hormonal, recreational, respiratory, or upright postural activity.

Whenever the upper trapezius is hyperactive with daily activity, the levator scapula and sternocleidomastoid are sure to become agonistic in activity because of their proximity attachment on the cranium and first cervical vertebra.^{1, 4-5, 27} These muscles can become primary muscles of respiration, parafunctional cervical extenders, dyssynchronously active during exhalation for postural reasons, and habitually preactivated upon mandibular opening. To reduce this activity and restore harmony between the posterior cranium rotators and the anterior rib depressors, the abdominal oblique muscles must be reasonably strong and balanced in strength between the left and right sides of the thoracoabdominal and abdominal-pelvic region. It is important to oppose the anterior and posterior thoracoappendicular musculature with abdominal oblique strength that is as strong or stronger than its opposition; otherwise, an FHP and a poor zone of apposition develops.^{6, 16, 20, 25} It is equally important to develop this abdominal oblique strength and opposition without involving the upper trapezius, anterior neck musculature, or anterior and posterior thoracoabdominal musculature.

ABDOMINAL OBLIQUE EXERCISES THAT MINIMIZE CERVICAL-CRANIO ACTIVITY

The following abdominal oblique exercises are designed to be performed without usage of upper thoracic and cervical musculature:

Balloon 4 “In” 3 “Out”

The balloon 4 “in” 3 “out” exercise is performed as follows (Fig. 4):

Position

- Lie on your back with knees and hips bent to 90° and feet on the wall or floor.
- Raise your right/left arm above your head, and hold the balloon in your opposite hand.
- Perform a posterior pelvic tilt, and keep low back flat during entire exercise.

Mechanics

- Inhale through your nose, and slowly blow out into balloon.
- Pause 3 seconds with tongue on the roof of your mouth to prevent airflow out of the balloon.
- Without pinching the neck of the balloon, take another breath in through nose.

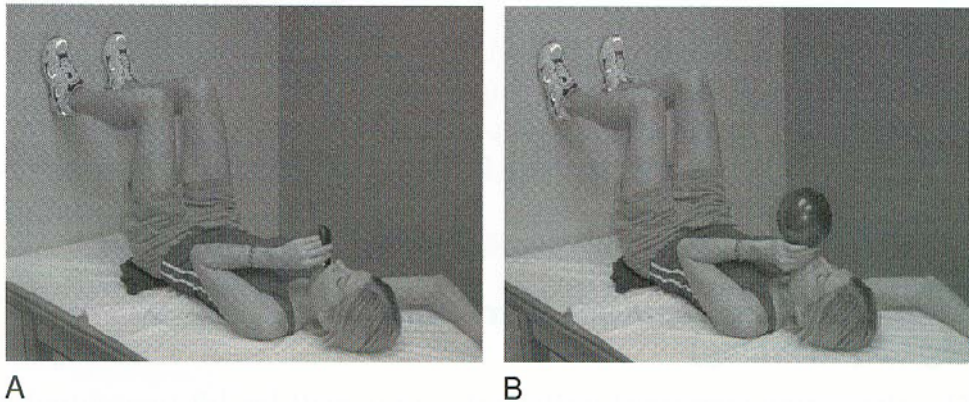


Figure 4 Balloon 4 “in” 3 “out.” *A*, Position. *B*, Mechanics.

- Slowly blow out again as you stabilize the balloon with your hand.
- Do not strain your neck or cheeks as you blow.
- After the fourth breath in, pinch the balloon neck, remove it from your mouth, and let the air out.

90-90 Supine Wall Leg Lift with Bolster

Reciprocal Unilateral Supine Wall Leg Lift

The 90-90 reciprocal unilateral supine wall leg lift with bolster is performed as follows (Fig. 5):

Position

- Lie on your back with knees and hips bent to 90° and feet on the wall.
- Place a bolster (3–4 inch) under your sacrum.
- Place both hands on your ribs.

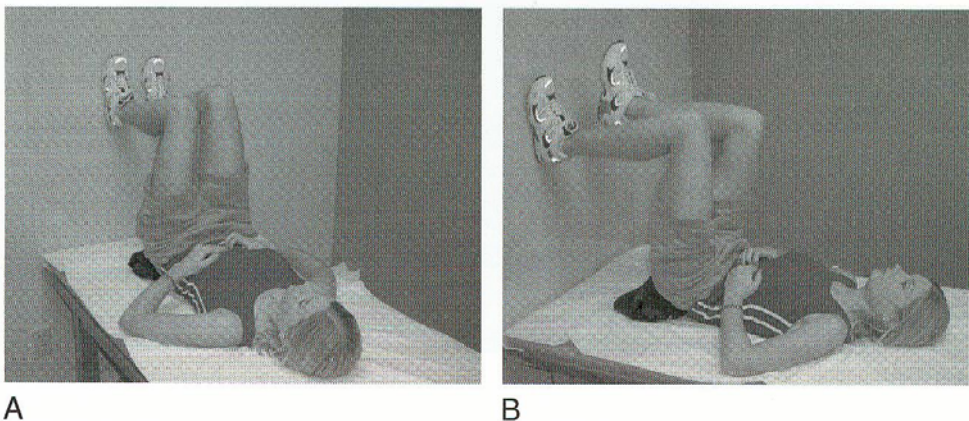


Figure 5 Reciprocal unilateral supine wall leg lift. *A*, Position. *B*, Mechanics.

Mechanics

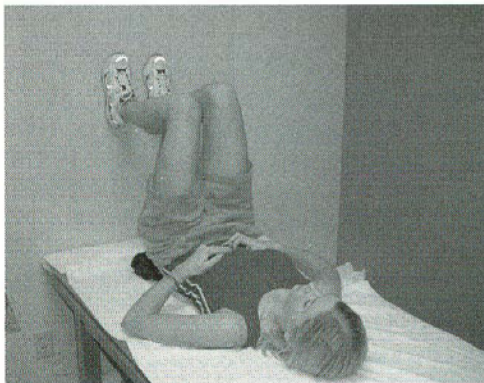
- Perform a posterior pelvic tilt as you keep low back flat by tightening your lower abdomen muscle.
- Establish and maintain a diaphragmatic breathing rate.
- Remove one foot off the wall (1–2 inches) as you rest the opposite heel on the wall.
- Return foot to the wall and repeat with the opposite leg.

Alternating Reciprocal Unilateral Supine Wall Leg Lift (Marching)

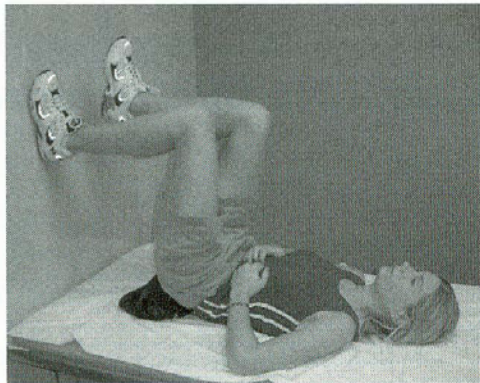
The alternating reciprocal unilateral supine wall leg lift (marching) is performed as follows (Fig. 6):

Position

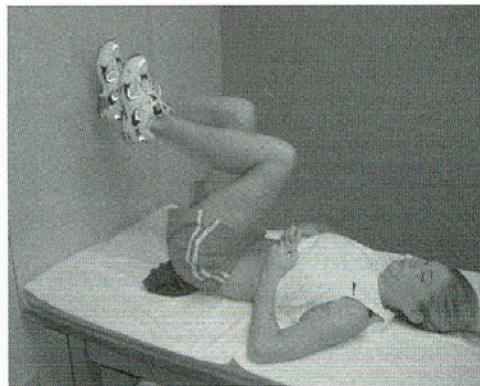
- Lie on your back with knees and hips bent to 90° and feet on the wall.
- Place a bolster (3–4 inch) under your sacrum.
- Place both hands on your ribs.



A



B



C

Figure 6 Alternating reciprocal unilateral supine wall leg lift (marching). A, Position. B, Mechanics.

Mechanics

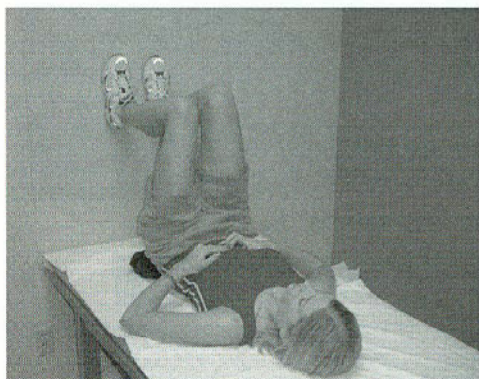
- Perform a posterior pelvic tilt as you keep low back flat by tightening your lower abdomen muscle.
- Establish and maintain a diaphragmatic breathing rate.
- While keeping your legs perpendicular to the wall remove your right/left foot off the wall (1–2 inches) as you rest the opposite heel on the wall.
- Return foot back to the wall.
- Repeat with the opposite leg after returning first leg to the wall.

Alternating Supine Wall Leg Lift (Bicycle)

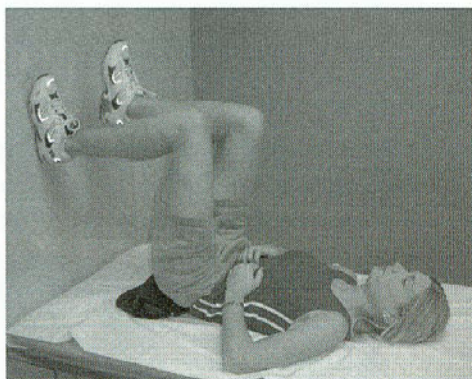
The alternating supine wall leg lift (bicycle) is performed as follows (Fig. 7):

Position

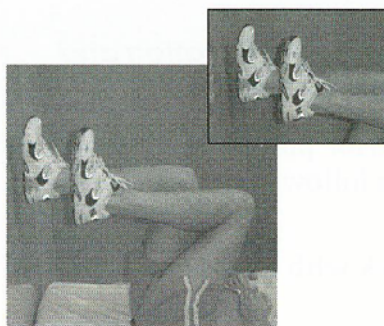
- Lie on your back with knees and hips bent to 90° and feet on the wall.
- Place a bolster (3–4 inch) under your sacrum.
- Place both hands on your ribs.



A



B



C

Figure 7 Alternating supine wall leg lift (bicycle). A, Position. B–C, Mechanics.

Mechanics

- Perform a posterior pelvic tilt as you keep low back flat by tightening your lower abdomen muscle.
- Establish and maintain a diaphragmatic breathing rate.
- While keeping your legs perpendicular to the wall, remove your right/left foot off the wall (1–2 inches) as your opposite heel rests on the wall.
- As your foot returns to wall, remove the opposite foot.
- Continue this pattern of movement, alternating one foot to the wall as the other leaves the wall, without using your neck.

Alternating Supine Wall Leg Lift (Bicycle) and Left Posterior Pelvic Rotation

The alternating supine wall leg lift (bicycle) and left posterior pelvic rotation is performed as follows (Fig. 8):

Position

- Lie on your back with knees and hips bent to 90° and feet on the wall.
- Place a bolster (3–4 inch) under your sacrum.
- Place both hands on your ribs.

Mechanics

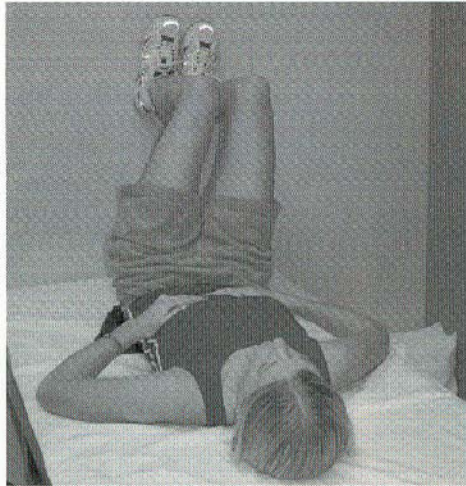
- Perform a posterior pelvic tilt by tightening your lower abdomen muscle.
- Establish and maintain a diaphragmatic breathing rate.
- Remove your right/left foot off the wall (1–2 inches).
- Remove the opposite foot to the same position.
- Slowly rotate knees to your right/left.
- Touch the wall with your right toes.
- Remove right toes off the wall as you slowly lower the left toes to the wall.
- Continue this pattern of movement, alternating one foot to the wall as the other leaves the wall without using your neck.

Alternating Posterior Pelvic Rotation and Reciprocal Bilateral Wall Leg Lift

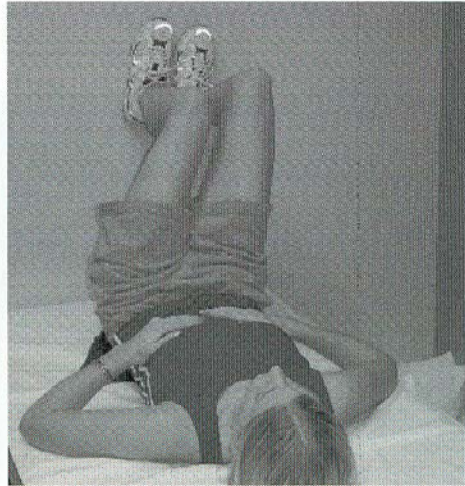
The alternating posterior pelvic rotation and reciprocal bilateral wall leg lift is performed as follows (Fig. 9):

Position

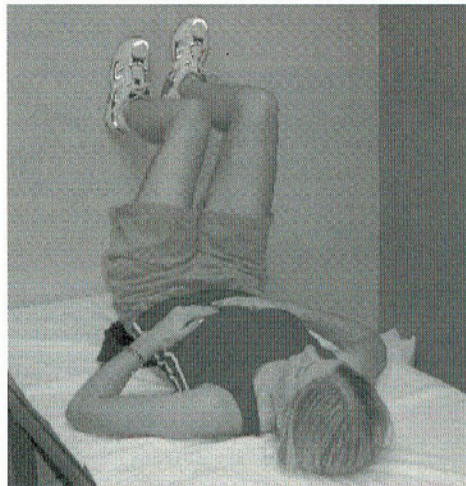
- Lie on your back with knees and hips bent to 90° and feet on the wall.
- Place a bolster (3–4 inch) under your sacrum.
- Place both hands on your ribs.



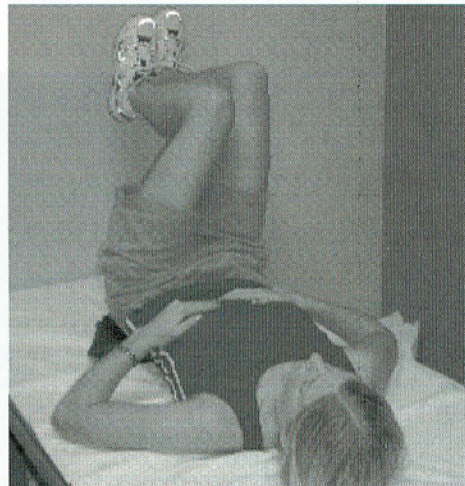
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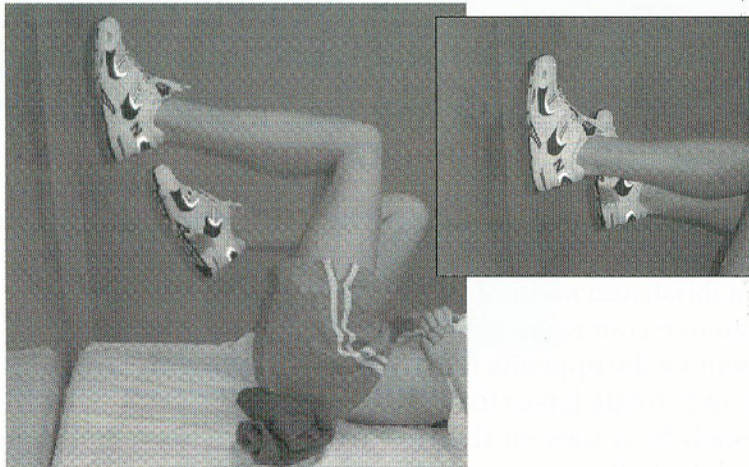
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C



D



E

Figure 8 A–E, Alternating supine wall leg lift (bicycle) and left posterior pelvic rotation.

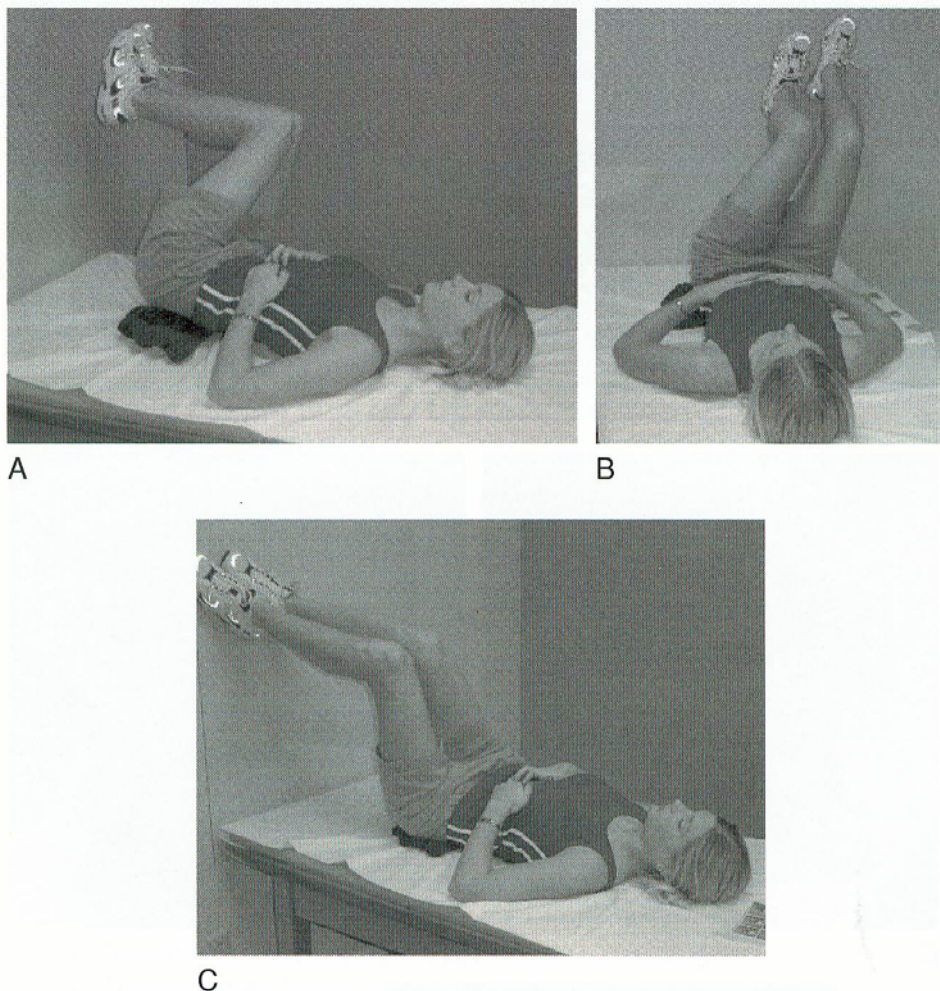


Figure 9 A–C, Alternating posterior pelvic rotation and reciprocal bilateral wall leg lift.

Mechanics

- Perform a posterior pelvic tilt by tightening your lower abdomen muscle.
- Establish and maintain a diaphragmatic breathing rate.
- Remove your right/left foot off the wall (1–2 inches).
- Remove the opposite foot to the same position.
- Slowly rotate knees to the right/left.
- Touch both toes on the wall at the same time, and then remove both feet off.
- Slowly rotate knees to the opposite side and repeat by touching the wall with both feet and lifting both feet off the wall at the same time without arching your low back.

Sidelying Knee to Knee

The sidelying knee to knee exercise is performed as follows (Fig. 10):

Position

- Lie on your right/left side with your back rounded and pelvis neutral.
- Place your feet together with toes on the wall.
- Extend your lower arm above your head and place your upper open hand on the floor.

Mechanics

- Shift your upper hip forward so that your top knee is in front of the bottom knee.
- Raise uppermost knee in the air.
- Hold this position as you bring the lower knee to the upper knee.
- Lower the lower knee; lower the upper knee.

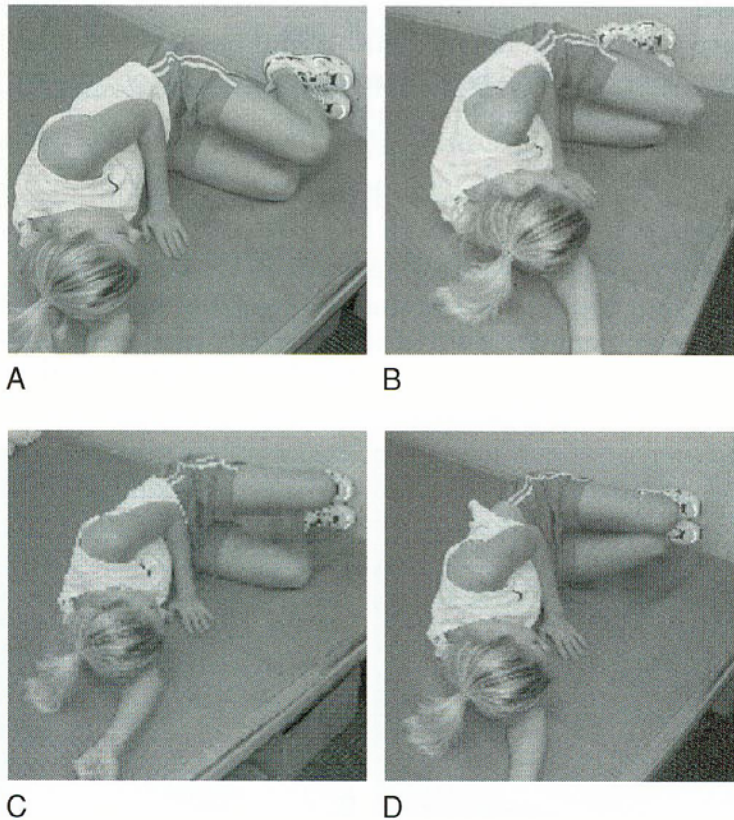


Figure 10 Sidelying knee to knee. A, Position. B–D, Mechanics.

Sidelying 90-90 Crossovers

Sidelying 90-90 crossovers are performed as follows (Fig. 11):

Position

- Lie on your back with lower body rotated to the right/left side and your right/left (same side as direction knees are pointed) arm parallel with your thighs.
- Place your opposite hand across your face touching your ear with elbow pointing straight up in the air.

Mechanics

- Slightly lift and rotate upper body to the right/left side (toward the same direction as knees are pointed) as you simultaneously shift forward the uppermost hip (knee comes forward).

90-90 Crossovers

90-90 Crossovers are performed as follows (Fig. 12):

Position

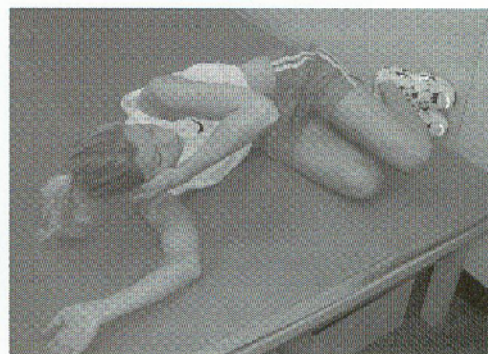
- Lie on your back with knees and hips bent to 90° and feet on the wall.
- Place your right/left hand behind your head.
- Place your opposite hand across your face touching your ear with elbow pointing straight up in the air.

Mechanics

- Perform a posterior pelvic tilt by tightening your lower abdomen muscle.
- Establish and maintain a diaphragmatic breathing rate.
- Shift your hip forward so that the right/left knee (corresponding to side with hand behind head) is slightly higher than the other.

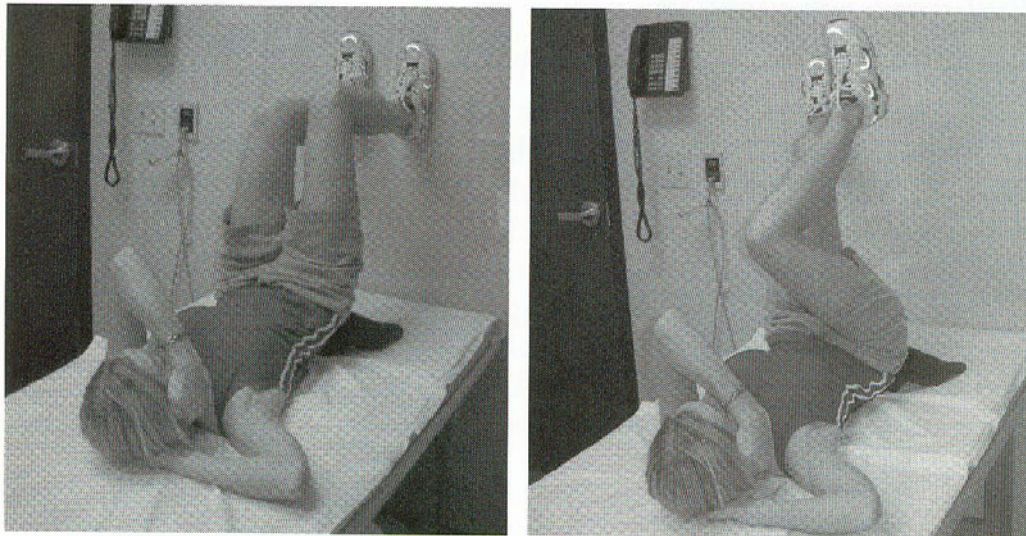


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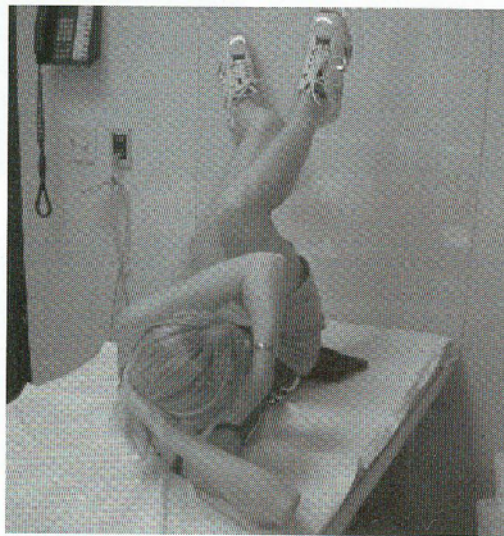
B

Figure 11 Sidelying 90-90 crossovers. *A*, Position. *B*, Mechanics.



A

B



C

Figure 12 A–C, 90-90 Crossovers.

- Bring the higher knee toward your opposite elbow.
- Rotate your upper body toward the knee while keeping the left/right hip shifted forward.

Trunk Arounds

Standing Trunk Arounds

Standing trunk arounds are performed as follows (Fig. 13):

Position

- Place theratube in door jam at the level of your shoulder and hold with your right/left hand.

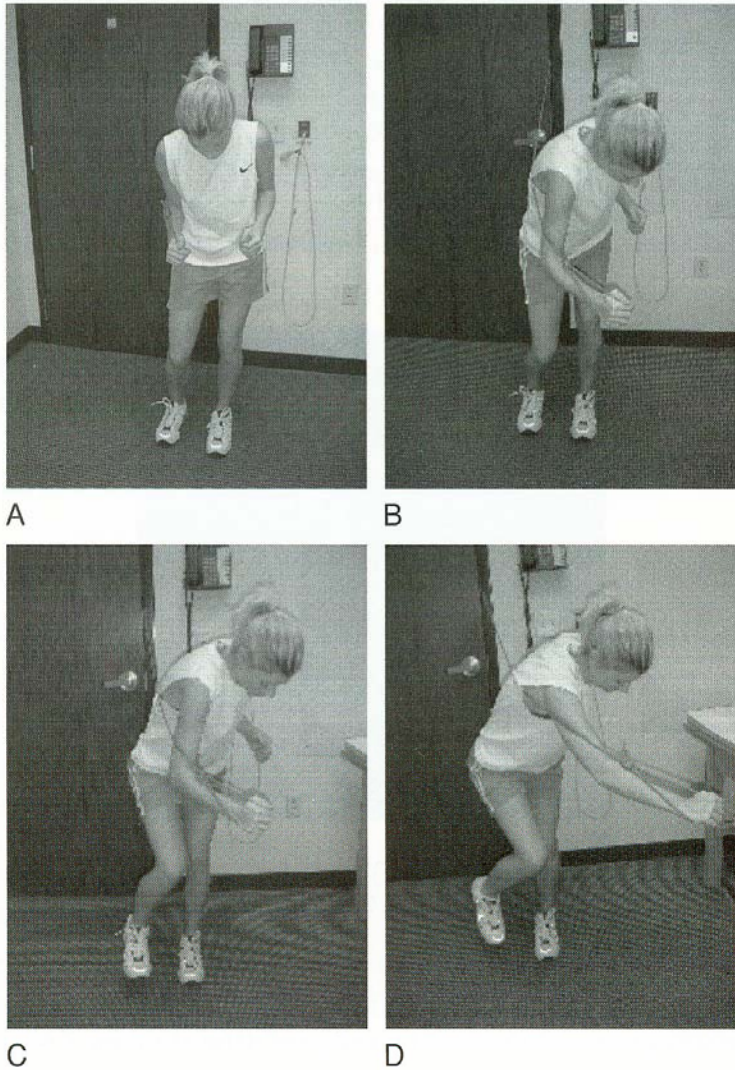


Figure 13 A–D, Standing trunk around.

- Stand perpendicular from the door with feet shoulder width apart and toes pointing forward.
- Elbows should be bent to 90° and at your side.

Mechanics

- Shift your center of mass to the side opposite the theratube and over your lower extremity.
- Pull your hand with the tubing down across the opposite non-moving knee as you flex your back and rotate your trunk around the nonmoving leg.
- Maintaining this position, pick up your right/left leg with knee flexed (same side as the tube-holding hand). Then slowly extend the arm with the tubing as you balance 3 to 6 seconds on the opposite leg.

Seated Trunk Arounds

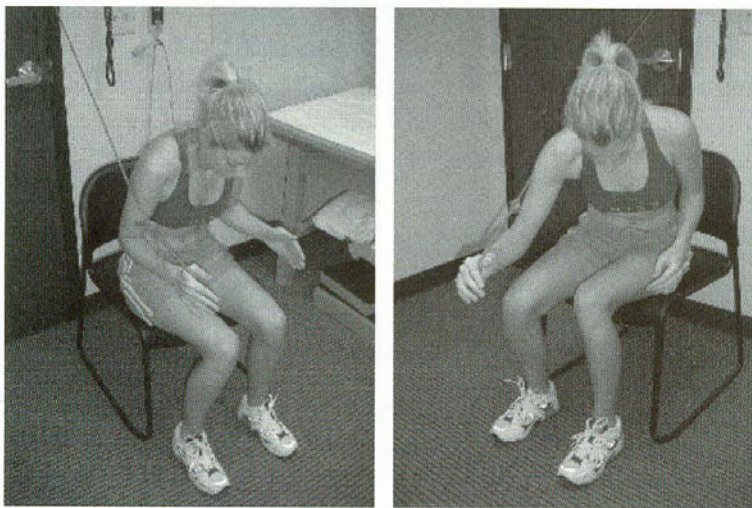
Seated trunk arounds are performed as follows (Fig. 14):

Position

- Place theratube in door jam at the level of the top of your head and hold with your right/left hand.
- Sit in a chair perpendicular to the door with toes pointing forward and elbows at your side.

Mechanics

- Pull your right/left arm forward and shift same-side hip forward at the same time as you rotate your trunk to the side opposite of tube hand.



A

B

Figure 14 Seated trunk around. A, Position. B, Mechanics.

SUMMARY

This article reviews the foundation relationship between thoracopelvic position and cervical-cranio orientation. Review of triplanar anterior and posterior thoracoappendicular musculature that is influenced by rib cage and pelvic position and thoracoabdominal and abdominal pelvic strength supports the concept of managing FHP and possibly TMD through specific abdominal oblique strengthening. Although there are studies that demonstrated poor correlations between posture and myofascial pain dysfunction³ and lumbar lordosis or anterior pelvic tilt and abdominal muscle performance,^{15,29} there are many practitioners who treat orofacial pain and TMD that incorporate and embrace postural stabilization and training. There is little research or discussion in the literature today on the influence of weak abdominal oblique musculature on cervical-cranio orientation or the relationship of thoracopelvic position to cervical-cranio orientation. Therefore, this overview of thoracopelvic mechanical influence on FHP, the muscles of the anterolateral abdominal wall, posterior and anterior thoracoappendicular wall, and the biomechanical implications of elevated anterior ribs and an anteriorly rotated pelvis on thoracoabdominal and abdominal pelvic strength supports the need for the practitioners to encourage their patients to initiate abdominal oblique strengthening exercises concomitantly with latissimus dorsi and pectoralis major stretching exercises. Suggested specific abdominal oblique exercises that minimize cervical-cranio activity are outlined and offered.

Temporomandibular dysfunction can develop from orthopedic postural problems that affect antigravitational-oriented musculature, which is necessary to maintain good cervical-cranio posture and good health.²¹ Without anterior chest wall flexibility, proper diaphragm opposition, abdominal oblique strength, and correct thoracopelvic position and symmetry, FHP, PCR, rounded shoulders, and TMD likely will manifest.

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