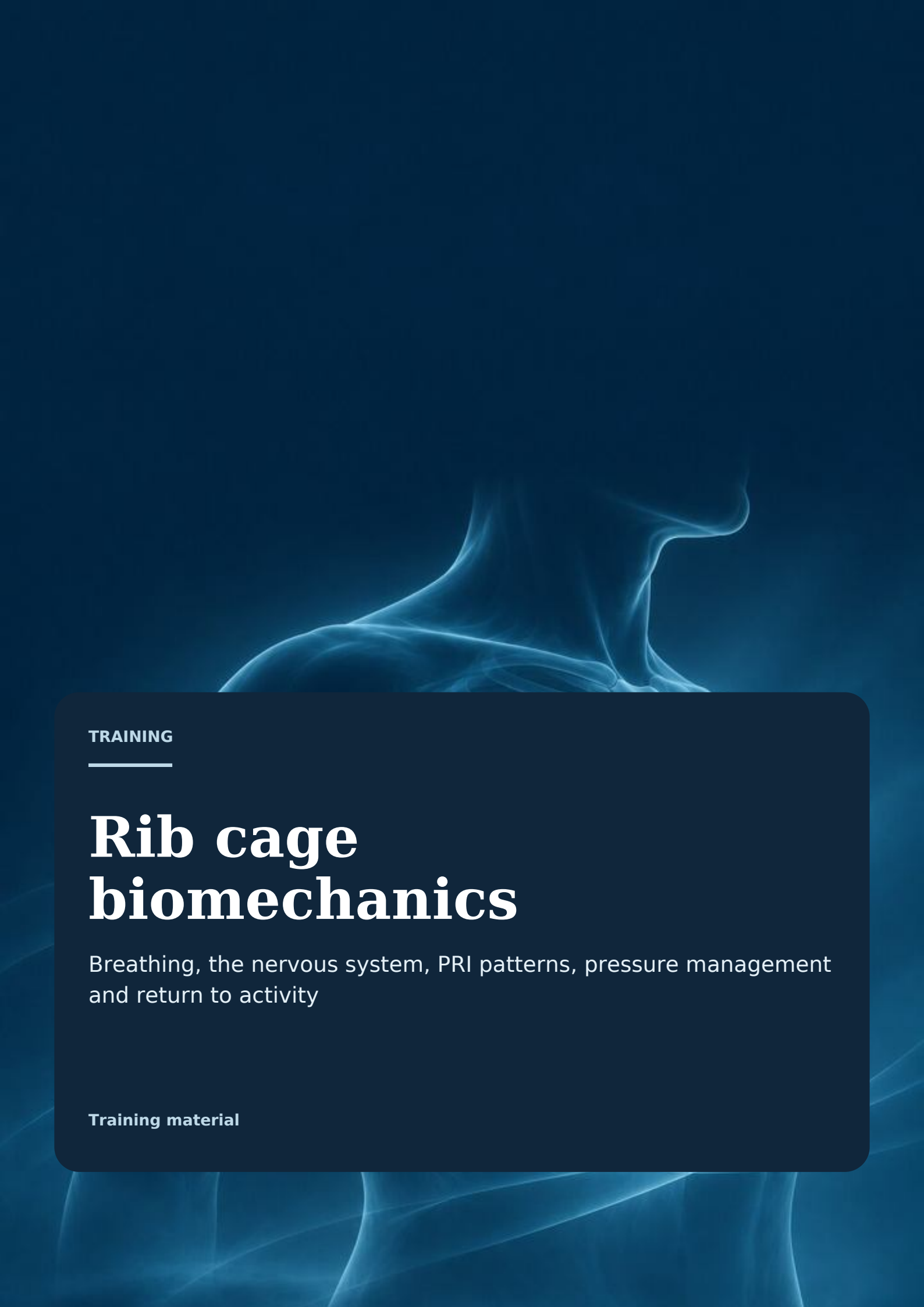


TRAINING

Rib cage biomechanics

Breathing, the nervous system, PRI patterns, pressure management and return to activity

Training material

Rib cage biomechanics

Breathing, the nervous system, PRI patterns, pressure management and return to activity

Overview

This material takes an integrated look at the rib cage as part of a system that continuously coordinates breathing, the diaphragm, pressure, the pelvis, weight-bearing, sensory information and movement. We start with how we breathe and how the rib cage moves, then examine asymmetries and the patterns described by PRI and their application to biomechanical reasoning.

The course examines two major ways movement options can narrow. The rotational Left AIC and Right BC patterns describe an asymmetrical strategy of the pelvis and rib cage. The PEC pattern involves an extension strategy, loss of stack, posterior compression and difficulty containing and distributing pressure. Applied cases connect these concepts with real movement.

The final part sets out a progression from rehabilitation to return to activity. Once stack, posterior expansion, weight-bearing and control have been recovered, the goal is to gradually regain tolerance of anterior pelvic tilt, extension, loading and movement, using eccentric control to expand the system’s options.

> **THE CENTRAL IDEA**
> **We aim for a body that can expand, compress, rotate, accept load, manage pressure and move between strategies instead of staying in one fixed posture.**

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> **CONCEPTUAL MAP**
> **Anatomy and breathing → nervous system and motor control → asymmetry and rotation → Left AIC / Right BC → stack and pressure management → PEC and posterior expansion → clinical application → return to activity and variability.**

This index introduces the course material developed so far.

Rib cage biomechanics

Introduction to breathing, the nervous system, the brain and movement patterns

Aim of the first part

The rib cage is a three-dimensional, dynamic structure. Beyond protecting organs and letting air move in and out, its position, mobility and capacity to expand and compress are part of an integrated system of breathing, motor control, the nervous system and movement.

The course examines how the rib cage works anatomically and functionally so that we can interpret limitations and movement strategies and judge their relevance to a musculoskeletal dysfunction or clinical presentation.

Functional anatomy asks what a structure can do, how it coordinates with the rest of the body and what happens when its movement options narrow.

1. The rib cage as part of an integrated system

The rib cage consists of ribs, sternum, thoracic spine, joints and muscle tissues. It is functionally linked with the diaphragm, lumbar spine, pelvis, shoulder girdle and cervical region. A change in rib cage orientation or mobility can alter the available breathing and movement strategies.

We look for variability: the ability to expand, compress, rotate, adapt to positions and meet the demands of a task.

2. Breathing is movement

Each respiratory cycle involves movement. On inhalation, the diaphragm descends, thoracic and abdominal pressures change, the ribs shift and thoracic volume increases. On exhalation, volume decreases and the relationships between the ribs, sternum, spine and muscles change.

We breathe while walking, running, lifting, reaching and shifting support. The system continuously coordinates breathing, pressure, stability and movement.

3. Breathing and the nervous system

Breathing is automatic and also under voluntary control. Brainstem networks generate its basic rhythm and chemical, mechanical, emotional and behavioural signals continually adjust it. Respiratory sensory input and changes across the respiratory cycle interact with brain networks involved in arousal, emotion and autonomic control.

The relationship goes both ways. Nervous system state can change how we breathe, and some changes in breathing can modulate aspects of autonomic activity and arousal.

Nervous system → breathing	Breathing → nervous system
Stress, threat, pain, exercise, emotion and cognitive demand can change breathing rate, depth and strategy.	Breathing rhythm and mechanics provide ongoing sensory information and may influence autonomic regulation and arousal.

A breathing pattern we judge inefficient does not automatically imply dysregulation of the nervous system. A particular way of breathing cannot, by itself, explain pain or dysfunction. Interpret breathing alongside context, symptoms, task and individual capabilities.

4. The brain, breathing and movement control

The brain organises actions rather than controlling muscles in isolation. It integrates visual, vestibular, proprioceptive, interoceptive and other sensory information, estimates task demands and selects a motor strategy.

Thoracic and abdominal pressure, rib position, and diaphragm and trunk muscle activity shape the mechanical conditions for movement. Breathing must coordinate with stabilisation, force production, rotation and locomotion.

With fewer breathing or thoracic options, someone may rely more on lumbar extension, rib elevation, accessory muscle activity, trunk stiffness or reduced expansion in certain areas. These may be useful solutions. Their clinical relevance increases if they are hard to adapt, coincide with symptoms or limit a task.

5. From breathing pattern to movement pattern

Body position shapes breathing mechanics. Breathing changes pressure and thoracoabdominal movement, which influence stabilisation and movement. The nervous system adjusts this cycle to the task and environment.

Nervous system / brain	Breathing	Rib cage	Movement pattern
Arousal Emotion Pain Motor control	Rhythm Volume Pressure Diaphragm	Position Expansion Compression Rotation	Stability Mobility Coordination Strategy

Read this model in both directions. Changes in nervous system state can affect breathing and muscle tone. A shift in rib cage position can alter breathing mechanics. A demanding task can change breathing, pressure and posture at the same time.

6. Clinical application

During assessment, ask which options the person has and uses. Can they expand different regions of the rib cage as they breathe?

Can they exhale without relying excessively on extension or stiffness? Can they breathe in different trunk and pelvic positions? Does breathing change during strength, gait, rotation or reaching tasks? Does a dominant strategy coincide with symptoms or limitations? Does a temporary change in position or breathing alter movement quality, range or symptoms?

These observations generate hypotheses to test with movement, reassessment and response to intervention. Breathing is one clinical variable among several.

7. Relationship to PRI

PRI focuses on the relationships between breathing, rib cage position, the pelvis, asymmetry and movement strategies. In the course we use these ideas to build clinical reasoning and explore how positions can facilitate or limit rib cage expansion and motor strategies.

Distinguish general anatomical and physiological principles from interpretations specific to PRI. The relevance of an asymmetry or pattern depends on the person, the task and the effect on function.

Central idea of the introduction

> **Breathing and movement continually interact through the rib cage, diaphragm, pressure, nervous system and motor control. Our clinical aim is to understand these interactions and expand a person's options for adapting.**

Reasoning sequence: anatomy → position → breathing → nervous system and motor control → mobility → movement pattern → assessment → intervention → reassessment.

PRI and rib cage biomechanics

Anatomical asymmetry, breathing, thoracic torsion and movement patterns

1. What is PRI?

PRI stands for Postural Restoration Institute. It is a US-based school and clinical framework for assessment and intervention that examines posture, breathing, bodily asymmetries, sensory information and movement.

The human body is anatomically asymmetric. The organs, diaphragm, lungs, heart and other structures differ between sides. PRI uses these asymmetries as a starting point for interpreting rib cage and pelvic orientation and the movement strategies that may follow.

The goal is to retain the capacity to alternate, rotate, expand and compress different areas as breathing and task demands change.

2. Asymmetry is normal; reduced options can matter

Right and left do not have to behave identically. Walking, running and many human actions alternate. Efficient movement requires us to accept load on one side, shift to the other, rotate the rib cage relative to the pelvis and continually change internal pressure.

In PRI, the clinical question is whether the person can move out of the dominant strategy. Asymmetry can be fully functional when enough variability exists. It may become relevant when associated with stiffness, reduced mobility, difficulty alternating, symptoms or task limitations.

> **“The problem is losing the ability to move in and out of our asymmetries.”**

3. The rib cage as a three-dimensional structure

The rib cage does not expand uniformly. Ribs can differ in orientation and the cage can be arranged in rotation or torsion, leaving different regions with different options for expansion and compression.

Region	Anterior	Posterior
Right	Tendency towards compression	Tendency towards expansion
Left	Tendency towards expansion	Tendency towards compression

This diagram expresses a tendency in the model. Both expansion and compression are necessary. A functional region can change state with the respiratory phase, posture and movement.

4. What gives rise to this organisation in PRI?

PRI relates it to internal anatomical asymmetries. The liver provides important support under the right hemidiaphragm, the heart occupies more space on the left, the lungs differ in shape and the two hemidiaphragms have different anatomical relationships.

These differences may affect each side's shape, position and mechanical advantage. PRI draws on them to model pressure, rib position and the rib cage–pelvis relationship.

Both hemidiaphragms contribute to inhalation. In the PRI framework, they may work from different positions and mechanical relationships, with distinct zones of apposition and capacity to manage pressure and rib motion.

5. Zone of apposition, pressure and rib position

The zone of apposition describes the relationship between the diaphragm's costal portion and the inner wall of the lower ribs. Rib and diaphragm position shape the diaphragm's capacity to generate pressure and achieve efficient expansion.

If an area stays predominantly expanded or compressed, its mechanical options can narrow. PRI breathing work often seeks to shift rib position and recover underused areas of expansion or compression.

6. From breathing to posture and movement

Breathing changes thoracic and abdominal pressure. These pressures interact with the diaphragm, abdominal musculature, spine and pelvis. A breathing strategy can form part of a postural strategy and help set the conditions for movement.

Anatomical asymmetry	Breathing and pressure	Rib cage–pelvis orientation	Motor strategy
Organs Diaphragm Lungs	Expansion Compression Zone of apposition	Rotation Translation Load	Gait Reaching Rotation Stability

The relationship also runs in reverse. Position and task affect breathing; the nervous system adjusts tone, rhythm and motor strategy; and sensory information from support, vision, the vestibular system and movement can change overall organisation.

7. Left AIC and Right BC

PRI uses patterns to describe common clinical presentations. Left AIC stands for Left Anterior Interior Chain and describes a dominant lumbopelvic orientation. Right BC stands for Right Brachial Chain and describes a compensatory arrangement involving mainly the rib cage, shoulder girdle and neck. In PRI these may be linked: pelvic orientation may be accompanied by a compensatory thoracic strategy.

Pattern sequence: position → pressure → orientation → sensory information → movement strategy. The muscular chains help explain how the arrangement can be maintained.

8. When does a pattern become a problem?

A preference or asymmetrical orientation can be functional. The pattern gains clinical relevance when someone struggles to change strategies: for example, when they cannot expand a region or accept load on one side, always rotate in the same direction, need excessive compensation or reproduce symptoms during a task.

Intervention aims to expand the available options: a compressed area can expand, an expanded one can compress, the rib cage can rotate either way, and the pelvis can alternately accept and transfer load.

9. Integration with the nervous system and brain

The brain organises movement from sensory information and context. PRI uses breathing, foot support, pelvic position, vision, head orientation and other sensory inputs to influence motor strategy.

A breathing exercise can change rib position and pressure, provide a different sensory experience and help make another movement strategy available.

10. Foundations of the PRI model

PRI draws on general anatomy and physiology: bodily asymmetry, differences between the hemidiaphragms, the effects of breathing on pressure and rib movement, and interactions between breathing, posture and motor control.

The specific quadrants, chains and patterns such as Left AIC and Right BC and their clinical interpretation belong to PRI. Treat them as reasoning tools and hypotheses to test against assessment, symptoms, function and response to intervention.

PRI views the body as an asymmetric system that needs to alternate. Breathing, pressure and rib cage and pelvic orientation contribute to alternation. The clinical aim is to expand options for breathing, loading, rotation and movement.

Conceptual sequence: anatomical asymmetry → mechanical differences → breathing and pressure → thoracic torsion/orientation → rib cage–pelvis relationship → PRI pattern → functional assessment → intervention → reassessment.

Left AIC and Right BC

Lumbopelvic and thoracic biomechanics in the PRI framework

Introduction to the pattern

PRI describes Left AIC/Right BC as a three-dimensional arrangement of the pelvis, spine and rib cage. Follow the sequence from respiratory and thoracic asymmetry to pelvic orientation, load distribution and muscular strategies that maintain or compensate for the position.

1. What does Left AIC mean?

AIC is Anterior Interior Chain. PRI describes an AIC on each side. When the left dominates, the left hemipelvis moves forward and the pelvis as a whole orients right. The left tends towards flexion/anterior tilt, abduction and acetabulofemoral external rotation. The right is relatively posterior and tends to support the centre of mass.

The right leg is not necessarily more capable. Prolonged right stance can hinder the transition to the left and limit use of the right gluteus maximus to exit that strategy.

2. How can this start with the rib cage and breathing?

The right hemidiaphragm has different structural and visceral relationships from the left. PRI proposes that this asymmetry favours a recurring torsional arrangement of the trunk. The ribs can be in different states of internal/external rotation, expansion and compression by region.

In Left AIC/Right BC, thoracic and respiratory organisation couples with the pelvis through torsion. The rib cage and pelvis orient in opposing directions to keep the gaze and body facing forward, while the centre of mass tends to remain right.

Region	Left AIC tendency	Functional consequence in PRI
Left hemipelvis	More anterior; flexion/anterior tilt; tends to abduction/external rotation	Difficulty accessing left acetabulofemoral internal rotation and fully accepting weight in left stance.
Right hemipelvis	Relatively posterior; dominant support side	Centre of mass tends to stay right. Exiting through right gluteus maximus/acetabulofemoral external rotation can be difficult.
Pelvis overall	Oriented right	Favours right stance and left swing; limits full alternation.

3. Key Left AIC muscles: position and access

PRI materials associate Left AIC with dominant facilitation of the left psoas and iliacus, left tensor fasciae latae and vastus lateralis, and contributions from the right hemidiaphragm, biceps femoris and adductors. This helps keep the pelvis oriented right.

Muscle/group	Tendency in the pattern	What to regain
Left hamstrings	Position puts them at a disadvantage for controlling the anterior hemipelvis.	Move the left hemipelvis posteriorly and regain sagittal control.
Left IC adductor	Difficult to recruit for functional left stance.	Left adduction and acetabulofemoral internal rotation, and load acceptance on the left.
Left anterior gluteus medius	May be hard to access within the dominant strategy.	Frontal-plane control of the pelvis in left stance.
Right gluteus maximus	Often hard to access for transverse-plane control and exit from right stance.	Right acetabulofemoral external rotation and a pelvic shift to the left.
Right adductor	May be overfacilitated, maintaining right stance.	Ability to reduce its contribution to allow a shift left.
Left psoas / iliacus	Facilitated in the Left AIC.	Alternate with extensors and stabilisers rather than dominating.
Left internal oblique / transversus abdominis	PRI describes reduced access to left abdominals in the combined pattern.	Left zone of apposition, rib control and ability to compress the left rib cage when needed.

PRI describes the left gluteus maximus as potentially strong in the shortened position of the forward hemipelvis, yet challenged when asked to produce force at length in left acetabulofemoral internal rotation. An isolated manual test cannot stand in for gait function.

4. How can someone move out of Left AIC?

Classic PRI repositioning first addresses the sagittal plane with the left hamstrings, then the frontal plane with the left IC adductor and the transverse plane with the right gluteus maximus. It aims to make left acetabulofemoral internal rotation and right external rotation available, letting the centre of mass move from right to left and then shift again.

> **Left hamstrings → left IC adductor → right gluteus maximus → left acetabulofemoral internal rotation → left stance → right swing becomes available.**

5. What is Right BC and why does it occur with Left AIC?

BC stands for Brachial Chain. PRI describes Right BC as a dominant upper-trunk pattern that often accompanies Left AIC. When the pelvis and lower trunk orient right, the upper rib cage compensates to keep the head, eyes and upper limbs functionally directed forward.

PRI materials describe the Right BC as bringing the rib cage forward and rotating it left. In the combined pattern, right ribs are more approximated and internally rotated, while the left wall is more divergent and externally rotated. This can limit right expansion and left compression in certain gait phases.

Area	Right BC tendency	PRI functional interpretation
Right rib cage	Ribs more approximated/internally rotated	Difficulty opening and filling the right rib cage when a right brachial inhale is needed.
Left rib cage	Ribs more divergent/externally rotated	Difficulty compressing the left side and retaining left zone of apposition.
Thoracic spine	Compensatory left upper-trunk rotation	Limits rotation alternation in gait.

Area	Right BC tendency	PRI functional interpretation
Scapulae	Altered relationship with an already rotated rib cage.	Serratus, trapezius and glenohumeral muscles work from different lengths and orientations.

6. Right BC musculature

In a rotated rib cage, a serratus or trapezius can be challenged on either side for different reasons. One may be lengthened and the other shortened and both can struggle within a task. PRI associates dominant Right BC with the right hemidiaphragm, left pectoralis, right transversus thoracis and right obliques, among others. Postural Respiration work seeks to recover left lower trapezius and serratus anterior function, followed by right lower trapezius and triceps.

PRI describes the left scapula as rounded, with a lengthened and challenged serratus anterior. The right serratus may be flatter and shorter yet also challenged. Function depends on three-dimensional rib cage position rather than simple weakness.

PRI considers the latissimus dorsi's ability to hold thoracolumbar extension and rotation and uses inhibition strategies when it dominates. A strong right latissimus cannot be inferred from Right BC alone; assess function.

7. How Left AIC and Right BC couple during gait

The left hemipelvis sits forward, the pelvis orients right and the upper rib cage compensates left, with the centre of mass easily held on the right. The person can walk, run and train, but may have fewer options for full alternation.

Step	What happens
1 · Left AIC	Left hemipelvis forward and pelvis oriented right.
2 · Dominant right stance	The centre of mass easily stays over the right leg.
3 · Compensatory Right BC	The upper rib cage orients and rotates the other way.
4 · Patterned breathing	Expanding right and compressing left can be difficult in the relevant phase.
5 · Reduced alternation	Full left stance and subsequent right swing are harder.

8. What to observe clinically

Can the person leave right stance and find the left heel, ischium and hip? Can they internally rotate at the left hip without compensating at the lumbar spine, knee or foot? Can they access left hamstrings and adductor without right adductor dominance, and right gluteus maximus to exit the right side?

Can they maintain the left abdominal wall and expand the left posterior mediastinum without anterior rib flare? Can they expand the right rib cage and allow right upper-trunk rotation when gait requires it? Do tests and function change after repositioning? In PRI, reassessment carries more weight than inferring the pattern from appearance.

9. Integrating Left AIC and Right BC

The combined pattern is a model of position, pressure, breathing and coordination. Pelvic position affects muscle length and available function. Rib cage orientation affects scapular and respiratory mechanics. The nervous system learns to use its most accessible options repeatedly.

The PRI goal is to regain alternation: right stance → left stance → right stance. Both sides can expand and compress, the trunk can rotate in both directions and muscles can work at different lengths and moments in gait.

Scope of the model

Left AIC and Right BC are clinical constructs specific to the Postural Restoration Institute. Anatomical asymmetry, interactions between breathing, pressure and movement and the dependence of muscle function on length and position are broader biomechanical principles. Their grouping into Left AIC/Right BC is specific to PRI and should be tested with clinical assessment and response to intervention.

PRI sources consulted

Postural Restoration Institute: On the Adduction Drop Test Positioning; On Left vs. Right Quad Function in the Left AIC Pattern; On Which Plane to use to Restore the Pelvis; Desired PRI Clinical Application for Integrated Gait Progression Activities; Postural Respiration materials; and clinical resources on Left Serratus Anterior and Right BC. The source records September 2026 as the consultation date.

Applied case: gymnast with Left AIC + Right BC

Sporting repetition, crossed pattern and pelvis–rib cage organisation



Observed pattern in the gymnast



Left AOS + right POS

Sensory inputs in the task

The internal oblique eccentrically controls the opposite gluteus maximus. The adductor is facilitated when the opposite first metatarsal presses into the ground. The rib cage rotates as the opposite latissimus reduces its contribution. Multi-joint chains work together with the appropriate sensory input.

1. Repetition and Left AIC

Repeated rhythmic gymnastics movements reinforce an arrangement with flexion and abduction of the left hemipelvis and extension and adduction of the right. We interpret it as compatible with Left AIC and a preferred pelvic orientation.

2. Right BC as an upper-body compensation

The pelvis turns right while the left arm reaches forward and the rib cage turns left. In PRI this crossed arrangement is interpreted as Right BC associated with Left AIC, allowing balance, direction and reach in the sporting movement.

3. Left AOS + right POS

The exercise illustrates cooperation between the left anterior oblique sling (AOS) and right posterior oblique sling (POS). The internal oblique contributes to eccentric control of the opposite gluteus maximus. Ground contact under the opposite first metatarsal facilitates the adductor. Thoracic rotation is organised as the opposite latissimus modulates its tension.

Foot support, push against the ground and limb position give the system sensory information that helps organise which muscles are facilitated, which work eccentrically and which contribute less to allow rotation. Multi-joint chains work together.

> **Case sequence: repeated jump → left hemipelvis flexion and abduction + right hemipelvis extension and adduction → Left AIC → pelvis right → left arm forward + rib cage left → Right BC → reinforced sport-specific crossed strategy.**

Application to the course

The aim is to regain options while keeping the rotation needed for gymnastics. After reorganising breathing, stack, support and alternation, the gymnast gradually returns to the specific movement, with eccentric control and the ability to move in and out of rotation.

Left AIC and Right BC are used here as PRI models to interpret the repeated pattern and its relationship to the sporting movement.

PEC: stack, posterior compression and pressure management

Rib cage and pelvic biomechanics, breathing and load distribution

1. PEC: another way movement options can narrow

Alongside rotational patterns like Left AIC and Right BC, PRI describes PEC, or Posterior Exterior Chain. This is a predominantly extended, forward-biased strategy with anterior pelvic tilt, thoracolumbar extension and flaring of the lower ribs. The ribs point up and out, tend toward external rotation and are less able to close during exhalation.

The rib cage and pelvis lose a relationship favourable for managing pressures. The anterior rib cage remains open while the posterior region can be relatively compressed and less able to expand.

2. The concept of stack

Stack is a functional relationship with the rib cage positioned over the pelvis. This lets the diaphragm, abdominals and pelvic floor manage pressure from a more efficient position without relying predominantly on lumbar extension and anterior rib flare.

In stack, lower ribs can descend during exhalation, the abdominal wall can contain and distribute pressure, and inhalation can expand the rib cage in three dimensions, including posteriorly.

Functional stack	Loss of stack
Rib cage over the pelvis	Rib cage shifts forward relative to the pelvis
Ribs can close and reopen	Ribs stay open/elevated
Favourable diaphragm–abdominal wall relationship	Dominant lumbar extension and anterior opening
Pressure contained and distributed	Pressure tends to dissipate
Posterior expansion available	Posterior compression and reduced expansion

3. Pressure and dissipation

Intra-abdominal pressure is an internal force needed for breathing, trunk stabilisation and force transfer. It naturally increases with effort, coughing, lifting and demanding movement.

Dissipation describes pressure directed to an area that cannot contain and distribute it efficiently. Pressure is present, but the wall cannot distribute force evenly. This may appear as local bulging, excessive thrust toward an area or reduced abdominal wall tension.

> **Pressure is the internal force we need to generate. Dissipation is the loss of capacity to contain and distribute it.**

This can help frame hernias mechanically: an area of the wall is less able to contain and transmit internal forces. Pressure management, tissue quality, wall geometry and the local load all matter.

4. From rib flare to posterior compression

With sustained anterior pelvic tilt and thoracic extension, the lower ribs open and orient forward. The centre of mass shifts forward, increasing forefoot load. The back may look extended while the posterior rib cage remains compressed.

The breathing goal is to restore posterior expansion by allowing space between the posterior ribs so breathing can mobilise the area again.

> **Anterior pelvic tilt → thoracolumbar extension → flared ribs → loss of stack → anterior centre of mass → reduced heel support → posterior compression.**

5. Heel, sensory information and hamstrings

A forward centre of mass reduces sensory input from the heel. Heel contact provides a reference for the nervous system to register a more posterior position and organise the muscles that support it.

Restoring heel support provides a posterior reference that facilitates hamstring participation. They can produce tension and help control the pelvis, reduce excessive anterior tilt and bring it into a more neutral relationship to the rib cage. The heel is both a mechanical support point and a sensory input that helps reorganise body position and recruit the posterior chain.

6. Reorganising the system

The intervention progressively rebuilds the relationship between rib cage, pelvis, breathing and support, starting with stack and then adding exhalation, abdominal wall, posterior expansion and foot loading.

Step	Aim
1 · Rib cage–pelvis stack	Reposition the rib cage over the pelvis and reduce extension dominance.
2 · Exhalation	Close the lower ribs and recover a more favourable diaphragm position.
3 · Abdominal containment	Use internal obliques and transversus abdominis to manage and distribute pressure.
4 · Posterior expansion	Inhale into the posterior and lateral walls without reopening the anterior ribs.
5 · Heel reference	Regain posterior sensory information and shift loading toward the heel.
6 · Hamstrings	Facilitate their participation in pelvic control and reduce the forward bias.
7 · Integration	Take the strategy into standing, gait, strength and movement.

7. Internal oblique, transversus abdominis and diaphragm

Internal oblique and transversus abdominis help the wall contain and distribute pressure, lower and control the lower ribs and improve the rib cage–pelvis relationship. The aim is pressure with movement: an active wall contains internal forces while the diaphragm continues breathing and the posterior cage expands.

8. Posterior expansion

The cue to “breathe into the back” aims to recover movement of the posterior ribs. After an exhalation that closes the anterior ribs, inhalation expands the posterior and lateral rib cage while retaining stack and avoiding an immediate return to lumbar extension. This reduces posterior compression, redistributes thoracic volume and opens up breathing and movement options.

9. Nervous system, protection and forward bias

Arousal and protective responses can favour a more forward-biased arrangement. With stress, threat, pain or high demand, the nervous system may increase muscle tone, shift breathing higher and use strategies that prepare the body to act.

In this context, a forward-biased posture may be interpreted as a protective strategy. Breathing, sensory information from support, autonomic state and body position influence one another.

Regaining stack, posterior support and three-dimensional breathing provides new sensory references and can facilitate a less forward-biased and more adaptable strategy.

> **Flared ribs + anterior pelvic tilt → loss of stack → reduced abdominal containment → pressure dissipation → posterior thoracic compression → anterior centre of mass → reduced heel reference → reduced hamstring participation → sustained anterior tilt.**

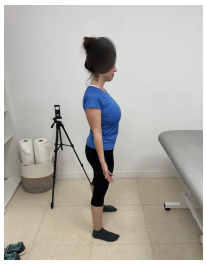
The intervention follows the reverse sequence: stack → exhalation → abdominals → posterior expansion → heel → hamstrings → pelvic reorganisation → integration into movement.

Clinical note

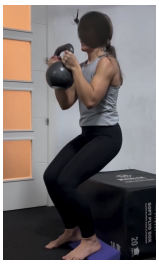
Stack, dissipation and posterior compression are biomechanical and teaching concepts used to organise assessment and treatment. A diagnosed hernia, abdominal mass, significant pain or new symptoms require medical assessment.

Applied case: PEC pattern

Pressure management, forward bias and restoring posterior expansion



PEC presentation: forward-biased strategy



Exercise: supported squat with a heel reference

1. Interpreting the pattern

In this case we interpret PEC as a mainly extended arrangement of pelvis and rib cage, with anterior pelvic tilt, flared ribs and a forward centre of mass. In the course framework, this changes the relationship between diaphragm, abdominal wall and pelvis, making pressures harder to manage and limiting posterior expansion.

The abdominal wall may transmit force inefficiently. Transversus abdominis, obliques and the rest of the abdominal fascial system help contain and distribute pressure. The aim is to rebuild the functional relationship between breathing, rib cage, pelvis and support.

2. Exercise objective

The heels-elevated kettlebell squat is used to reorganise PEC in a loaded task. A heel block provides a clear sensory reference, the front weight acts as a counterbalance, and flexing hips and knees lets the body move back without relying on lumbar extension.

Reference	Aim
Heel block	Increase the heel reference and let the centre of mass move back.
Kettlebell in front	Counterbalance to allow depth without relying on lumbar extension.
Lowering	Quadriceps and hip extensors control the descent eccentrically.
Rising	Gluteus maximus and quadriceps produce concentric hip and knee extension.
Breathing	Retain stack and seek posterior and lateral thoracic expansion.

3. What to feel during the movement

On descent, we look for an organised rib cage–pelvis relationship, contained abdominal pressure and room for posterior expansion. Heel support provides a sensory reference for greater knee and hip flexion with a controlled descent.

Quadriceps control knee flexion eccentrically and hip extensors regulate the descent. On ascent, gluteus maximus and quadriceps extend the hip and knee concentrically. The aim is to produce force without immediately reverting to anterior tilt, rib flare and lumbar extension.

4. Sensory and respiratory integration

The block changes ankle mechanics and gives a sensory reference at the heel. With exhalation and abdominal control, it shifts perceived load back. Inhalation then expands the posterior and lateral ribs while maintaining stack.

> **Heel reference → controlled flexion → eccentric quadriceps + hip control → stack and abdominal containment → posterior expansion → concentric gluteus maximus and quadriceps → integrate the pattern under load.**

The initial strategy restores pressure, posterior expansion, heel support and control. Then progress to physiological anterior tilt and extension without losing stack or returning to the initial rigid strategy. PEC is used here as a PRI framework. The photos illustrate the strategy and exercise.

From rehabilitation to return to activity

A personal interpretation: regaining physiological anterior pelvic tilt while retaining stack

Starting point

Once pressure management, posterior expansion, load distribution and the ability to alternate are restored, posterior tilt and expansion have served as tools to regain options. The next phase restores gradual access to anterior pelvic tilt, extension and anterior loading while preserving control.

The spine as a spring

Cervical lordosis, thoracic kyphosis and lumbar lordosis combine mobility, stiffness and capacity to absorb and transmit load. Think of the spine as a three-dimensional spring. Its curves, discs, joints and muscles distribute force in several directions through compression, tension, shear, and flexion and extension moments.

Pelvis, spine and rib cage have a natural relationship specific to each person. The aim is the ability to move between anterior and posterior tilt without becoming fixed at either extreme.

From correction to tolerance

In rehabilitation, stack, exhalation, abdominal muscles, heel support, hamstrings and posterior expansion helped the system leave a forward-biased strategy. As symptoms diminish and movement becomes more efficient, can the person re-enter a previously poorly tolerated position with control and without reproducing symptoms?

My proposal is graded re-exposure to anterior pelvic tilt. The neurosensory system learns to increase lordosis, tilt the pelvis forward and accept anterior load while retaining pressure control and a functional rib cage–pelvis relationship.

Stack as a capacity

Stack becomes the ability to keep the rib cage, pelvis, diaphragm and abdominal wall working together as position changes. The person can partly leave geometric alignment to move and still control pressure and muscle tension and return.

1 · Restore	2 · Control	3 · Expose	4 · Integrate
Stack and posterior expansion; restore hamstring and abdominal function.	Small anterior tilt without losing pressure; keep tension as muscles lengthen.	Increase anterior tilt, extension and loading; progress eccentric work.	Add speed, strength, sport and fatigue; alternate strategies freely.

The key: eccentric control

After regaining hamstring, internal oblique, transversus abdominis and other stack-related muscle participation, teach these muscles to keep tension as they lengthen. They progress from repositioning the body to braking movement in the opposite direction.

Internal oblique and transversus abdominis allow the ribs to reopen and expand while retaining some abdominal wall tension. Hamstrings let the pelvis tilt forward and the hip change position while continuing to regulate movement. The aim is to slow anterior tilt, tolerate it and come out of it.

A neurosensory progression

If the system has associated safety and control with heel support, relative posterior tilt and posterior expansion, gradually expand its movement map. Progressive exposure can make positions previously associated with threat or symptoms available again. Advance from slow, controlled tasks to more range, load, speed and variability so the person can move in and out of flexion, extension, anterior and posterior tilt, expansion and compression.

> **First restore a position from which the system can breathe, distribute load and move without symptoms. Then gradually teach the body to leave that position. Rehabilitation restores options. Return-to-activity training teaches the body to use them under load.**

This is a personal clinical interpretation. It uses stack and posterior expansion as a starting point to restore physiological variability in the spine and pelvis through graded exposure and eccentric control.