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Spinal Column in the Sagittal Plane – Part II
Thoracic Kyphosis, Thoraco-Lumbo-Sacral Lordosis, and Systemic Compensations

Editorial Note
This article represents Part II of the chapter dedicated to the spinal column in the sagittal plane and is the direct continuation of Part I.
Reading this content presupposes knowledge of the biomechanical principles developed in the first part.

3. Thoracic kyphosis (T4-T6)

3.1 Geometric and functional characteristics

Thoracic kyphosis geometrically represents the posteriorly convex junction between the two anterior convexities of the cervico-thoracic and thoraco-lumbar lordoses.
It extends from the spinous processes of T4 to T6, with a physiological apex at T5.
Anatomical reference: when it follows a physiological course, the apex of the T5 spinous process is aligned with the medial border of the scapulae, and the scapulae lie at the sides of the rib cage.

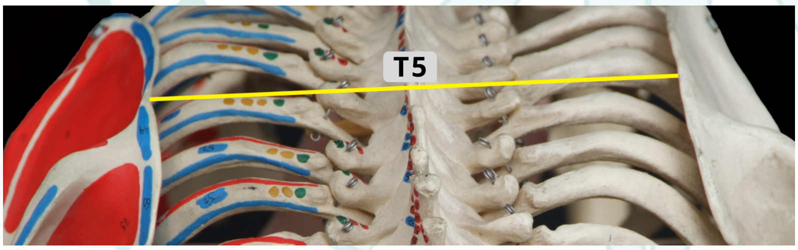


Figure 24: Physiological kyphosis - the apex of the T5 spinous process lies on the same line as the medial border of the scapulae.

3.2 Muscles acting on the kyphotic segment

The muscles that directly affect this segment of the spine are all posterior:

- Paravertebral muscles (with longitudinal force lines)
- Rhomboids (with oblique force lines)

- Middle and lower fibres of the trapezius (with oblique force lines)

The paravertebral muscles, rhomboids, and middle and lower fibres of the trapezius all reduce the physiological thoracic kyphosis with apex at T5.

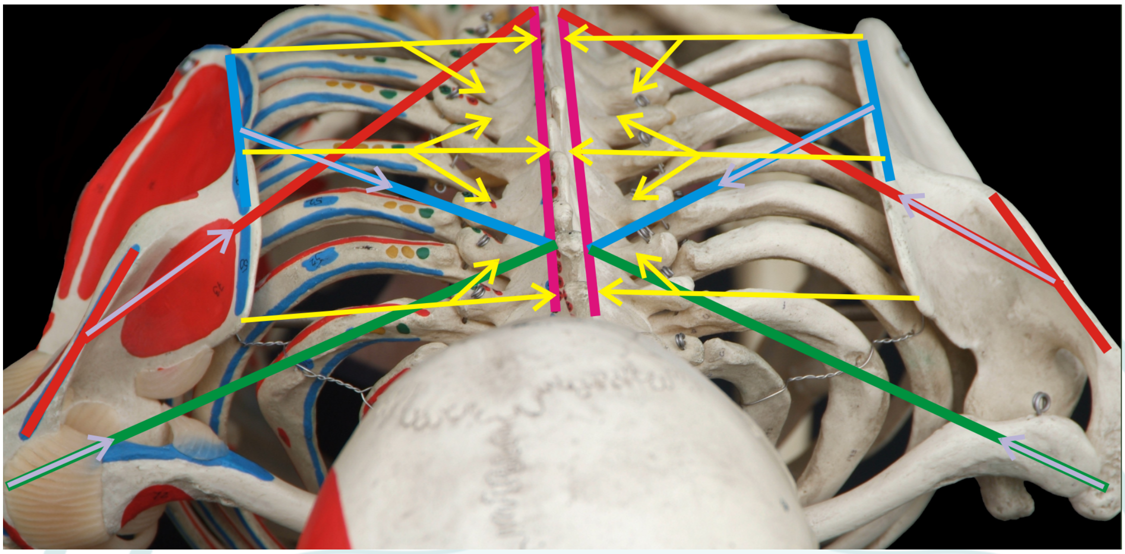


Figure 25: Muscles represented - vertebral insertion of rhomboids, middle and lower trapezius fibres: magenta; rhomboids: blue; middle trapezius fibres: green; lower trapezius fibres: red; direction of muscular vectors (spinal column as fixed point): light purple arrows; skeletal resultants of muscular actions: scapular adduction and vertebral sinking with consequent reduction of the physiological kyphosis with apex at T5: yellow arrows

3.3 The mechanism of thoracic hypokyphosis

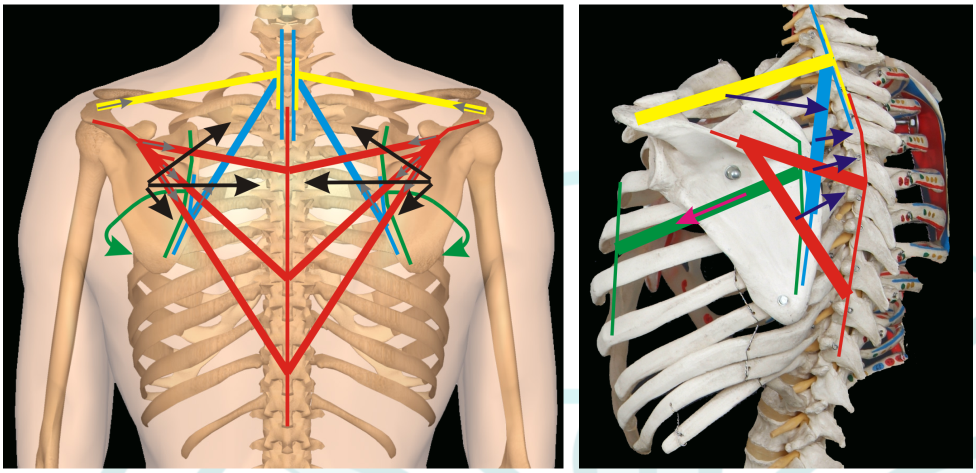
Scapular adduction as the primary cause
As already observed, thoracic hypokyphosis produced by the middle and lower fibres of the trapezius and by the rhomboids occurs through scapular adduction. This is an important concept for understanding the biomechanics of the thoracic segment.

Vector imbalance between scapular adductors and abductors
The balancing force against scapular adduction is provided by the serratus anterior, which, however, has lower vector potential and is therefore subdominant.
This vector inferiority becomes even more pronounced if one considers that the upper trapezius fibres and the levator scapulae also participate in scapular adduction.
The pulling force of the scapular adductors prevails over the force by which the serratus anterior keeps the scapula attached to the rib cage.
It is therefore not the scapulae that "move outward," but the spine that "moves inward," compressing the intervertebral discs.

Deformation of the rib cage
The serratus anterior, in attempting to balance the adductors, with the scapula becoming its fixed point and the ribs its mobile point, produces:

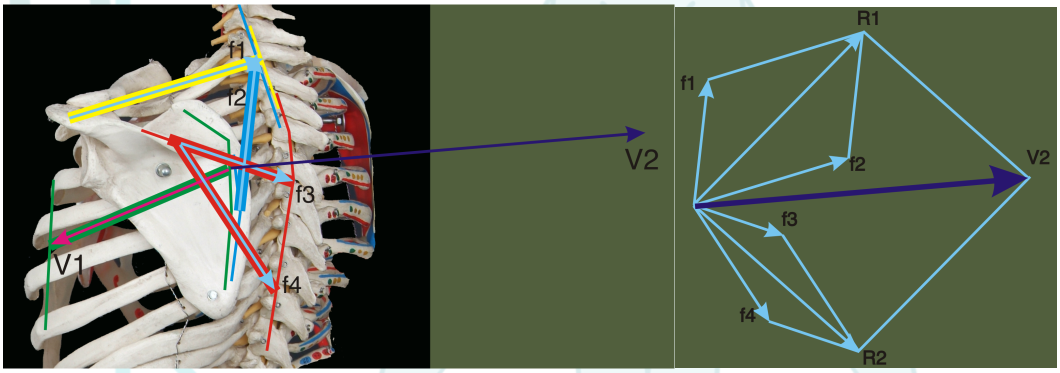
1. An increase in the transverse diameter of the thorax
2. A decrease in the anteroposterior diameter between sternum and spine, due to the anterior projection of the infra-scapular vertebrae produced by the adductors

The thorax loses its physiological “roundness” and becomes ovalized.
This ovalization prevents the scapulae from positioning themselves at the sides of the rib cage as skeletal physiology would require.



Figures 26 and 27: The horizontal vector components of the scapular adductors are such that they cannot be effectively balanced by the vector of the serratus anterior. Consequently, shortening of the middle and lower trapezius fibres and of the rhomboids causes scapular adduction and sinking of the vertebral segment between T4 and T6. Middle trapezius fibres: yellow; rhomboids: blue; lower trapezius fibres: red; serratus anterior: green

Quantitative vector analysis
Using the parallelogram rule, it is possible to calculate the force ratio between scapular adductors and abductors.



Figures 28 and 29: By using the parallelogram rule, it is possible to calculate the vector V2 potentially produced by the combined forces of the rhomboids f2 and the middle f1 and lower f3 and f4 fibres of the trapezius (light blue arrows). The calculation shows that vector V2 (blue arrow) is more than twice as long as vector V1 potentially produced by the serratus anterior (magenta arrow). This means that, in order to balance an adductory force on the scapula produced by the rhomboids and the middle and lower fibres of the trapezius, the serratus anterior must use a traction force more than twice as great. The calculation is not exact - it should be performed on the actual length of the muscles - but it gives an idea of the reciprocal force ratio. Middle trapezius fibres: yellow; lower trapezius fibres: red; rhomboids: light blue; serratus anterior: green

The dominant muscular action on the infra-scapular portion is therefore one of straightening, that is, hypokyphosis of the spinal segment T4-T6.

Clinical manifestations of hypokyphosis

Figures 30 and 31: In the photographs, the scapulae have lost their physiological position at the sides of the rib cage, moving into adduction toward the spine. Because of the action of shortened scapular adductors, the spine remains within the scapular plane, that is, in hypokyphosis with apex at T5, with consequent compression of the intervertebral discs. The serratus anterior, unable to balance scapular adduction, expresses its shortening by exerting traction on the lateral thoracic wall, deforming it. The rib cage increases its transverse diameter due to the serratus anterior and decreases its anteroposterior diameter due to the scapular adductors projecting the vertebrae toward the sternum.

3.4 The hyperkyphotic pattern: an apparent contradiction

The true nature of hyperkyphosis

In hyperkyphotic patterns, an apparently contradictory but biomechanically demonstrable phenomenon occurs:

- T5 is still sunk inward because of the action of the scapular adductors;
- the kyphotic apex is displaced caudally between T7 and T12 because of the action of the thoraco-lumbar muscles;
- a curve inversion occurs.

Hyperkyphosis is therefore only apparent.
The true anatomical hyperkyphosis is the one with apex at T5. In that segment, however, vector dominance is always toward reduction of kyphosis.
When the apex of kyphosis is below or above T5, it would be more correct to speak of curve inversion.

Mechanism of development of apparent hyperkyphosis

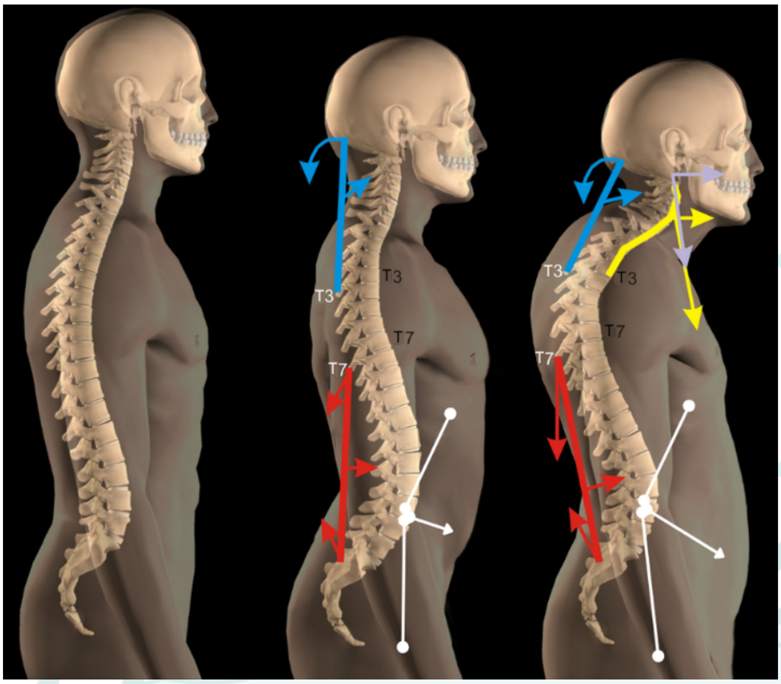


Figure 32: The figure shows an example of the progressive onset of a hyperkyphotic pattern: the muscles of the cervico-thoracic lordosis increase lordosis and project the head anteriorly to maintain horizontal eye orientation; the physiological kyphotic segment T4-T6 is straightened by the action of the scapular adductors; the diaphragm-psoas pair pulls the lumbar spine anteriorly; the muscles of the thoraco-lumbar lordosis, especially the latissimus dorsi thanks to its vertebral insertions down to T7, in addition to increasing lordosis itself, project the last thoracic vertebrae posteriorly and toward the ground, so that they become the apex of the apparent kyphosis through curve inversion. Force lines of the vector-dominant muscles acting on cranium, spine, and pelvis - thoracic muscles: red; cranio-cervico-scapular muscles: blue; anterior paravertebral muscles and scalenes: yellow; sternocleidomastoid muscles: light purple; diaphragm and psoas muscles: white

Sequence of systemic compensations
In summary:

1. Cervico-thoracic muscles: increase lordosis and project the head anteriorly.
2. Scapular adductors: straighten the T4-T6 segment, the true physiological kyphosis.
3. Diaphragm-psoas pair: pull the lumbar spine anteriorly.
4. Thoraco-lumbar muscles: project the T7-T12 vertebrae posteriorly, creating the apparent kyphotic apex.

Clinical example of curve inversion: following sinking of C4, clinical observation often reveals a curve inversion at the C6-T2 level, with C7/T1 creating only an apparent apex of kyphosis. The vertebrae are naturally not in kyphosis, but in curve inversion.

3.5 Clinical case: treatment of hyperkyphosis

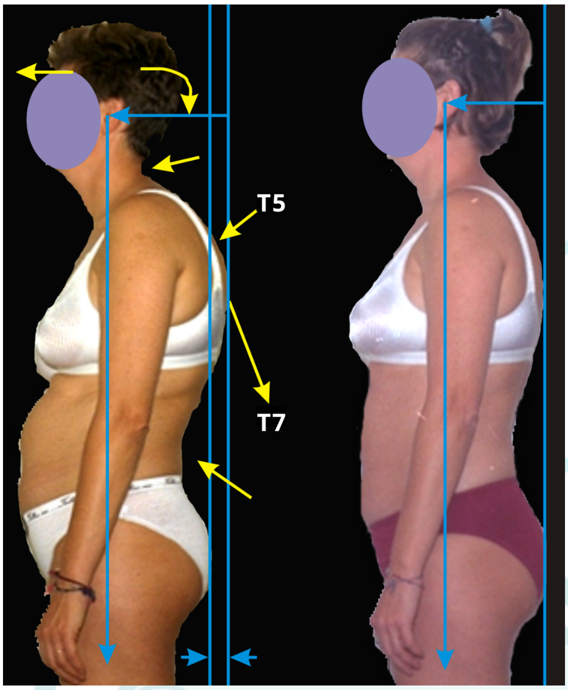


Figure 33: Photograph on the left: first examination; photograph on the right: end of treatment. Example of treatment of a "hyperkyphotic" pattern. Hyperkyphosis is supported by increased thoraco-lumbar lordosis with posterior projection of T7 and by cervico-thoracic lordosis with anterior displacement and posterior flexion of the cranium. The thoracic segment with apex at T5 appears straightened and oblique. The weight loss is only apparent; the patient's body weight remained unchanged. The sensation of "slimming" is produced by the change in the vertebral sinusoid, which allowed a better distribution of skeletal volumes.

Therapeutic strategy
Therapeutic treatment was planned with the aim of:

1. Reducing cervico-thoracic and thoraco-lumbar lordoses
2. Reducing hypokyphosis with apex at T5 in order to restore the physiological kyphotic pattern, through analytical and systemic re-lengthening of the acting muscles

Biomechanical outcomes
The improvement in the sinusoidal course of the spine allowed:

- the g and r components to redistribute more uniformly;
- a reduction in mechanical compressions on the intervertebral discs;
- the system to decrease stiffness and recover dynamic capacity, moving closer to the "edges of chaos."

3.6 Diagnostic considerations

For correct diagnosis, it is important to distinguish between:

1. True hypokyphosis, that is, reduction of the physiological kyphosis T4-T6
2. Apparent hyperkyphosis, that is, curve inversion with displaced apex

The common objective is always the recovery of the physiological kyphotic pattern at T5.
The therapeutic means are the same, namely analytical and systemic muscular re-lengthening, but the target muscles change:

- in hypokyphosis: re-lengthening of the scapular adductors (rhomboids, middle and lower trapezius fibres) to allow the physiological kyphosis to re-express itself;

- in apparent hyperkyphosis: re-lengthening of the muscles of the cervico-thoracic and thoraco-lumbar lordoses to reduce the compensations that create the curve inversion.

Understanding that the true physiological kyphosis is located at T5, and that vector dominance in this segment is always toward reduction of kyphosis, makes it possible to orient both diagnosis and treatment correctly.

4. Thoraco-Lumbo-Sacral Lordosis (T7-S1)

4.1 Dominant vectors

At the lumbar level, the dominant vectors with direct spinal insertion are:

Posteriorly:

- Paravertebral muscles
- Quadratus lumborum
- Latissimus dorsi

Anteriorly:

- Diaphragm (crura)
- Iliopsoas

Lumbar lordosis is prolonged by the vertebral insertions of the latissimus dorsi down to T7, creating a continuous functional unit.

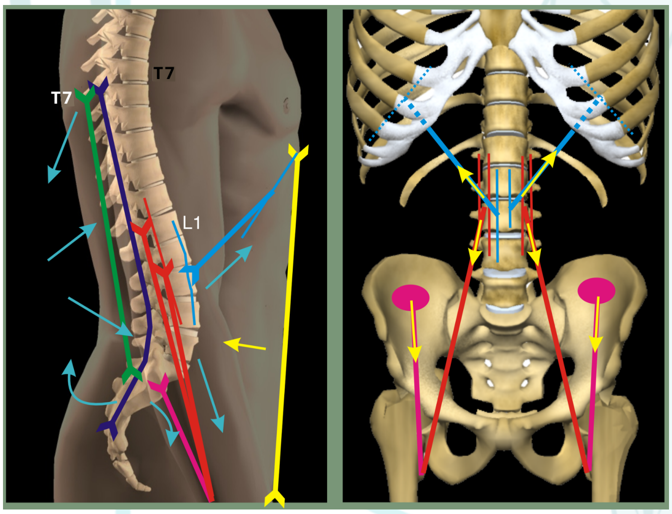


Figure 34 - Muscles acting on thoraco-lumbar lordosis: latissimus dorsi: green; paravertebrals: blue; psoas: red; iliacus: magenta; diaphragm: light blue; rectus abdominis: yellow. The paravertebrals between T7 and the sacrum directly increase lordosis and anteriorly tilt the pelvis. The fibres of the latissimus dorsi between the thoracic vertebrae (T7-T12) and the iliac crests project the thoracic vertebrae posteriorly and toward the ground and anteriorly tilt the pelvis, thereby increasing lumbar lordosis. The crura of the diaphragm pull the lumbar vertebrae from L1 to L4 anteriorly toward the thorax. The psoas pulls the vertebrae between T12 and L4 anteriorly toward the femur. The iliacus anteriorly tilts the pelvis. Together, all these muscles increase

thoraco-lumbar lordosis and anteriorly tilt the pelvis. The only antagonists are the rectus abdominis muscles, which, having no direct spinal insertion, are subdominant.

4.2 Vector dominance

All the muscles acting with spinal insertion are co-agonists in increasing thoraco-lumbar lordosis. The only antagonists are the rectus abdominis muscles, which, having no direct spinal insertion and being vectorially weaker, are subdominant.

Analysis of force lines
The rectus abdominis muscles have a vertical force line that produces only minor horizontal vectors.
Their ability to restrain lumbar lordosis is linked to their capacity to stiffen the abdominal wall.
The muscles with vertebral insertion have both oblique and vertical force lines.
They produce vectors that, even with a small increase in basal tone, are capable of modifying the course of the spine.

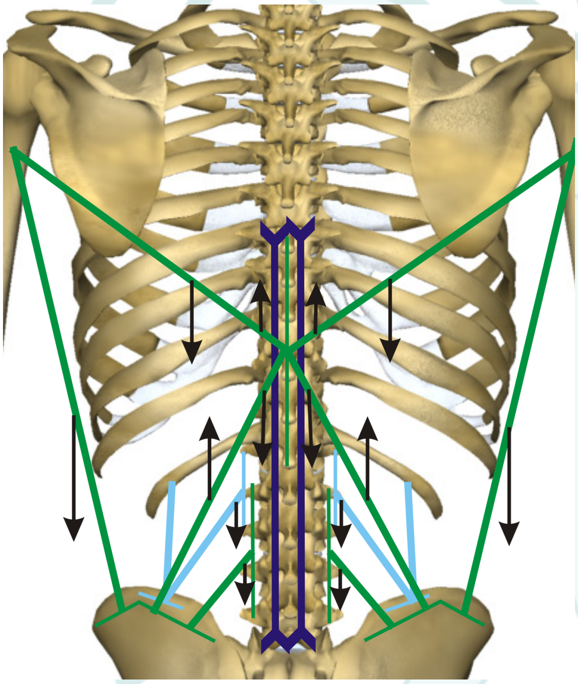


Figure 35 - The black arrows indicate the longitudinal vector components of the latissimus dorsi and quadratus lumborum which, added to those of the paravertebrals, in addition to stiffening the spine and projecting the vertebrae anteriorly, determine compression of the intervertebral discs. Latissimus dorsi: green; paravertebrals: blue; quadratus lumborum: light blue

4.3 Biomechanical consequences

Oblique force lines have vertical vector components which, added to those of the paravertebral muscles:

- increase lordosis;
- produce stiffening of the spine;
- cause compression of the intervertebral discs.

Latissimus dorsi, paravertebrals, and iliacus create a force moment that may produce anterior pelvic tilt.
Equilibrium is highly unstable: even modest shortening of the muscles acting directly on the spine produces modification of the thoraco-lumbar curve.

4.4 Distribution of forces on the discs

When lordosis is increased, the individual G and R forces applied to each vertebral body produce, through their g and r components, compressions on the intervertebral discs.
The overall G and R forces may fail to meet on a disc and, if their junction occurs on the articular facets, mechanical compressions may be created that can potentially degenerate into fractures of the facets themselves.

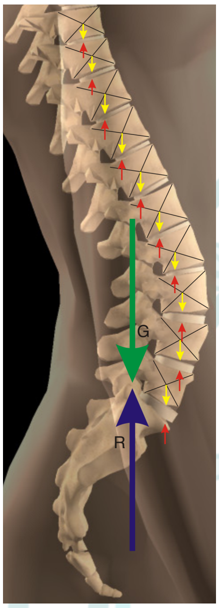


Figure 36 - Increased thoraco-lumbar lordosis. The individual G forces (yellow arrows) are balanced by the individual equal and opposite R forces (red arrows). Their g and r components, more concentrated at the point of intersection of the projection of the individual G and R forces, generate mechanical compressions on the intervertebral discs. The overall G and R forces, instead of being "absorbed" by the discs, load the articular facets of the lumbosacral joint.

4.5 Lumbar straightening

In some radiographic patterns, straightening of the lumbar segment can be seen. Since locally the muscles all act to increase lordosis, verticalization may be the resultant of:

- extreme anterior pelvic tilt;
- reduction of thoracic kyphosis.

Geometric mechanism

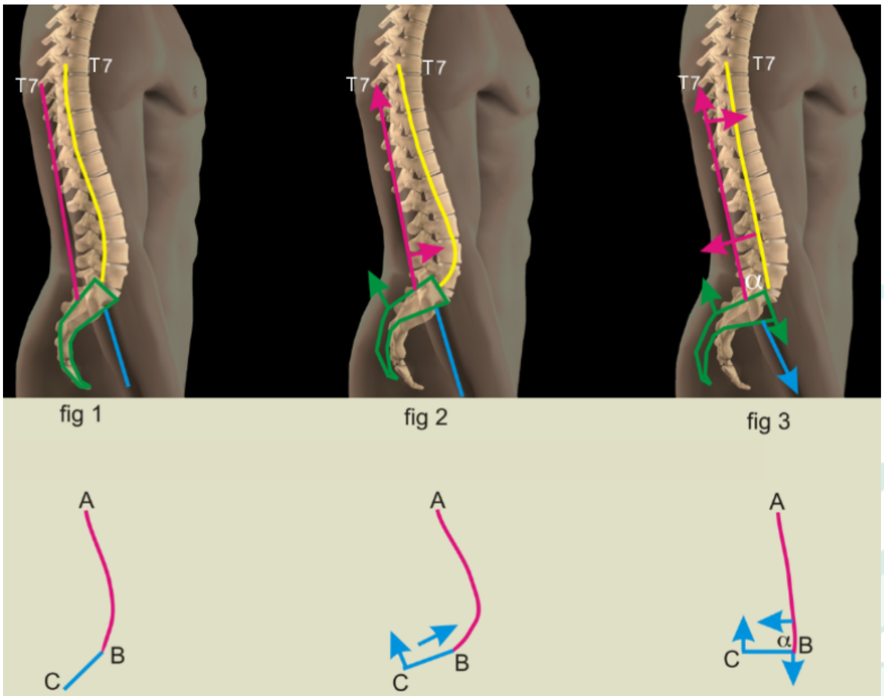


Figure 37 - Geometric analysis - latissimus dorsi: magenta; iliacus: blue; simulation of the progressive course of the spinal column: yellow; simulation of the progressive course of the sacrum: green. Segment AB (magenta): progressive course of the spinal column; segment BC (blue): progressive course of the sacrum. Geometrically, if point A is fixed and point C moves toward the horizontal of B, segment AB increases its curvature. But if horizontalization of segment BC is determined by the upward movement of point C and the downward movement of point B, segment AB progressively becomes a straight line. At the intersection of the two lines, the angle α is created.

Biomechanical sequence

1. Latissimus dorsi and paravertebrals anteriorly tilt the pelvis. If anterior tilt is further increased by the additional traction of latissimus dorsi and iliacus, then, in order to remain upright without falling forward, T7 would function as a fixed point.
2. The lumbo-sacral curve will therefore be transformed into two straight segments with an angular apex at the fifth lumbar vertebra.

The reduction of lumbar lordosis is therefore the product of the exacerbation of the traction forces that increase lordosis, with particular involvement of the latissimus dorsi-iliacus pair.
With horizontalization of the sacrum, a force moment is also created between the sacrum and the fifth lumbar vertebra.
This moment, by projecting the fifth lumbar vertebra anteriorly, may create a listhesis.

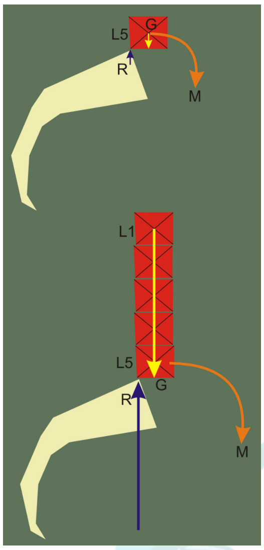


Figure 38 - The G force applied at the centre of gravity of L5 creates a force moment M with the R force applied to the sacrum. The more vertical the thoraco-lumbar lordosis becomes, the greater the overall G force applied to the fifth lumbar vertebra. Consequently, the intensity of the R force applied to the sacrum and the moment M will increase, raising the likelihood of a listhesis developing between L5 and the sacrum

4.6 Straightening due to reduction of thoracic kyphosis

Lumbar lordosis may also be reduced as a consequence of reduced thoracic kyphosis caused by the scapular adductors and the thoracic paravertebral muscles.
In this case, the reduction in lordosis does not affect only the thoraco-lumbar segment but also the cervico-thoracic segment, as a geometric resultant.

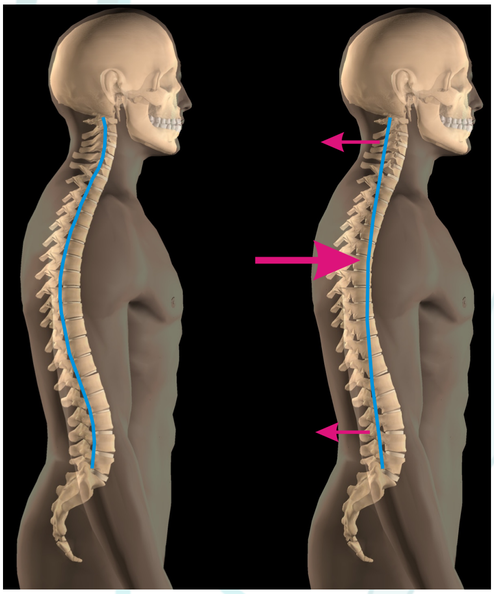


Figure 39 - Simulation of spinal course from physiological to vertical: blue; major shortening of the scapular adductors: thick magenta arrow; mechanical reduction of the lordoses: thin magenta arrows. If no significant shortening is present at the thoraco-lumbar and cervico-thoracic levels, straightening of the spinal column as a whole may be produced, excluding specific pathologies such as ankylosing spondylitis, by a marked reduction of thoracic kyphosis due to the action of the scapular adductors. In this case, by restoring the kyphotic pattern with apex at T5, the physiological lordoses above and below will reappear.

4.7 Pelvis

In upright standing, the anteroposterior stability of the pelvis is determined by two antagonist groups:

Anterior tilt:

- Latissimus dorsi
- Paravertebrals

- Iliacus
- Rectus femoris

Posterior tilt:

- Hamstrings
- Rectus abdominis

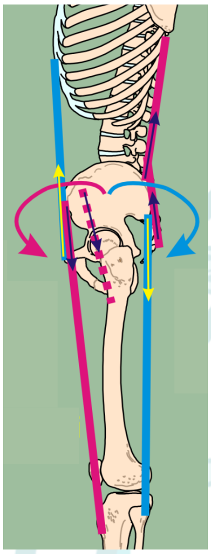


Figure 40 - Muscle groups - anterior tilt: latissimus dorsi, iliacus, paravertebrals, rectus femoris (magenta); posterior tilt: hamstrings, rectus abdominis (blue)

The dominant vector force favours anterior tilt, mainly because of the great pulling force that can be expressed by the latissimus dorsi.

Most frequent clinical patterns

1. Wide-range excess of thoraco-lumbar lordosis with anterior pelvic tilt
2. Verticalization of the lumbar segment associated with horizontalization of the sacrum and an angular fulcrum at the fifth or fourth lumbar vertebra

Patterns in which, still in upright standing, the dominant vectors are the muscles producing posterior pelvic tilt are less frequent.
In this case:

- the pelvis will be posteriorly tilted and the knees will often be flexed;
- the lumbar spine may appear straight because of the mechanical push induced by posterior pelvic tilt;
- or it may appear hyperlordotic due to the pulling effect of the diaphragm-psoas pair.

In the latter case, the spine will be subjected to the action of a pair of opposite forces.

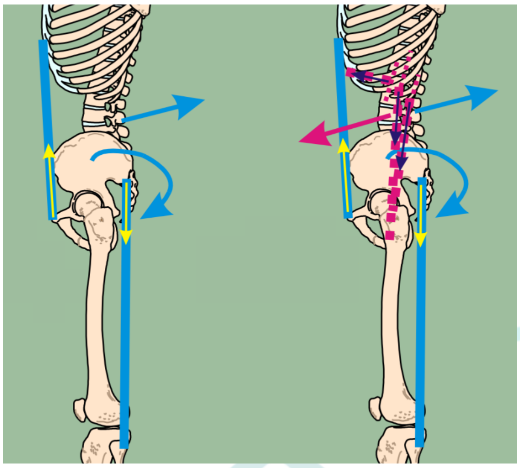


Figure 41 - Muscle groups - hamstrings, rectus abdominis: blue; diaphragm, psoas: magenta

5. Conclusions

5.1 Summary of sagittal muscular actions

In upright standing, the muscles acting directly on the cranio-sacral sinusoid in the sagittal plane may produce:

Cranium

- Anterior flexion: through the action of the sternocleidomastoids.
- Posterior flexion: through the action of the upper trapezius fibres and cranio-vertebral paravertebrals. If the cranium is in posterior flexion, the sternocleidomastoids invert their action and become co-agonists of the posterior flexors.
- Anterior displacement: through the action of the scalenes. Once the cranium has been anteriorly displaced, the anterior neck muscles and sternocleidomastoids also participate in the action.
- Posterior displacement: through the action of the upper trapezius fibres and, if posterior head flexion is associated with increased cervical lordosis, through the action of the levator scapulae and paravertebrals.

Cervico-thoracic lordosis

- Straightening: through the action of the scalenes and anterior neck muscles, the cervical spine is projected forward, becoming straight and oblique. Straightening may also be caused indirectly by reduction of thoracic kyphosis; in this case, the spinal column will have a straight and vertical course.
- Hyperlordosis: through the direct action of the scalenes, levator scapulae, paravertebrals, and suprahyoid muscles; indirectly, through posterior flexion of the head by the action of the upper trapezius fibres.
- Kyphosis with apex at C7/T1: as the mechanical resultant of anterior projection of the cranium or as a consequence of sinking of the C3-C4 vertebrae.

Thoracic kyphosis with apex at T5

- Straightening: through the action of the middle and lower trapezius fibres, rhomboids, and thoracic paravertebrals.

Thoracic kyphosis with apex between T6 and L1

- Accentuation: due to the action of the latissimus dorsi, with insertions on the spinous processes from T7 to T12, which project the vertebrae posteriorly and toward the ground, producing curve inversion relative to the physiological alignment.

Thoraco-lumbar lordosis

- Straightening: as a consequence of horizontalization of the sacrum produced by the latissimus dorsi, iliacus, and rectus femoris. T7, for maintenance of upright standing, acts as a fixed point. The lumbo-sacral curve is transformed into two straight segments, determining the formation of an angle at the lumbo-sacral transition. Straightening may also be the mechanical resultant produced by posterior pelvic tilt or by reduction of thoracic kyphosis with apex at T5.
- Hyperlordosis: through the direct action of latissimus dorsi, paravertebrals, psoas, diaphragm, and quadratus lumborum.

Pelvis

- Anterior tilt: through the action of latissimus dorsi, paravertebrals, iliacus, and rectus femoris.
- Posterior tilt: through the action of the hamstrings and rectus abdominis.

5.2 Interpretative principles

Not all patterns have the same probability of occurring. By applying vector analysis to the acting muscles, dominant patterns emerge that indicate the most frequent possibilities of action.
Any modification in one spinal segment, by changing the centre of gravity, requires involvement and modification of the other portions.
The district analysis proposed here should not be understood as local, but as the reading of an interdependent system in which every segmental variation changes the overall equilibrium of the vertebral sinusoid.

5.3 Representation of dominant patterns

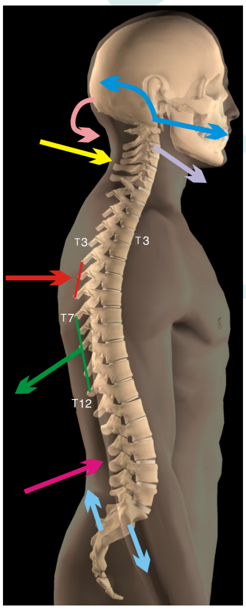
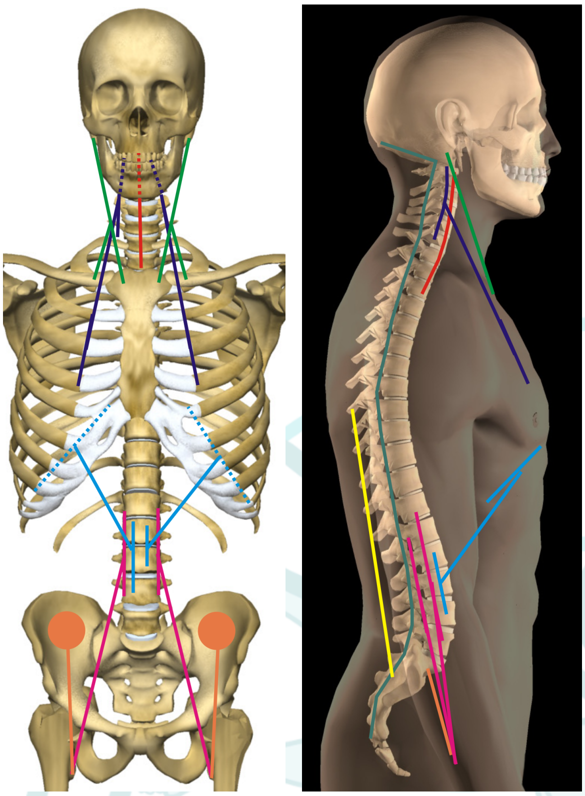


Figure 42 - Vector-dominant muscles acting on cranium, spine, and pelvis - anterior displacement with posterior flexion of the cranium: sternocleidomastoids (blue arrows); posterior flexion of the cranium: paravertebrals, upper trapezius fibres (pink arrow); straightening with oblique course of the C1-T3 column: scalenes, anterior neck muscles (light purple arrow); hyperlordosis C1-T3: paravertebrals, levator scapulae, scalenes, anterior neck muscles, suprahyoid muscles (yellow arrow); straightening T4-T6: rhomboids, middle and lower trapezius fibres, paravertebrals (red arrow); kyphosis T7-T12: latissimus dorsi (green arrow); hyperlordosis T7-L5: latissimus dorsi, paravertebrals, diaphragm, psoas, quadratus lumborum (magenta arrow); anterior pelvic tilt: latissimus dorsi, iliacus, paravertebrals (light blue arrows)



Figures 43 and 44 - Force lines of the vector-dominant muscles acting on cranium, vertebral sinusoid, and pelvis - anterior and lateral view. Sternocleidomastoid: green; anterior neck muscles: red; paravertebrals: dark green; diaphragm: light blue; psoas: magenta; iliacus: orange; latissimus dorsi: yellow; scalenes: dark blue

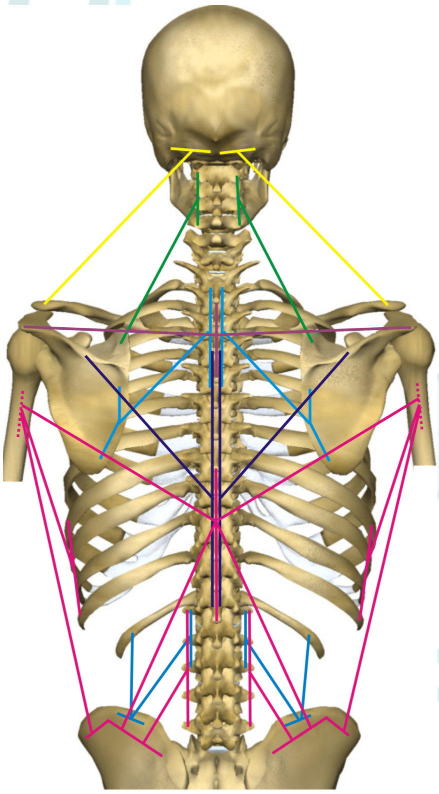


Figure 45 - Force lines of the vector-dominant muscles acting on cranium, vertebral sinusoid, and pelvis - posterior view. Upper trapezius fibres: yellow; levator scapulae: green; middle trapezius fibres: purple; rhomboids: light blue; lower trapezius fibres: dark blue; latissimus dorsi: magenta; quadratus lumborum: blue

5.4 Clinical considerations

Understanding vector dominance and the mechanisms of systemic compensation forms the basis for:

1. carrying out differential diagnosis between primary causes and secondary compensations;
2. choosing therapeutic strategies targeted to the muscles responsible for the alterations;
3. predicting the evolution of clinical patterns;
4. monitoring the effectiveness of therapeutic interventions.

The vector approach to the sagittal plane of the spinal column therefore provides the interpretative tools needed to transform clinical observation into precise biomechanical diagnosis, and the considerations set out here do not represent the conclusion of a chapter but the beginning of a different level of interpretation: every clinical datum becomes the visible expression of physical relationships governing the entire system.
Observation of sagittal modifications shows how every morphological variation of the spine reflects a different balance between muscular vectors and resistant forces.
Physiological curves do not represent fixed configurations, but dynamic adaptations generated by the continuous balancing of G and R forces, M moments, and the elastic properties of tissues.
From this perspective, spinal form is not a rigid anatomical datum, but the result of a vector system in unstable equilibrium.

6. Chapter summary

Myofunctional subdivision alongside the anatomical one
The spine is functionally divided into: cranio-cervico-thoracic lordosis (C0-T3), thoracic kyphosis (T4-T6), and thoraco-lumbo-sacral lordosis (T7-S1). Muscular insertions do not respect traditional anatomical boundaries.

Unique characteristic of the cranio-cervico-thoracic segment
It is the only segment with paravertebral muscles having dual anterior and posterior insertion. The posterior muscles always act to increase lordosis; the anterior muscles may invert their action depending on cranial position.

Inversion of action of the anterior cervical muscles
Sternocleidomastoids and anterior neck muscles reduce the curve in physiological lordosis; in hyperlordosis, their force line passes posteriorly, making them co-agonists of the posterior muscles in increasing lordosis.

Anterior projection of the cranium for horizontal gaze
In upright standing, when the posterior muscles create hyperlordosis with posterior flexion of the head, the anterior muscles project the cranium forward to restore horizontal gaze orientation.

Vector dominance of the scapular adductors
Rhomboids and middle-lower trapezius fibres are dominant over the serratus anterior. It is not the scapulae that “move outward,” but the spine that “moves inward,” creating hypokyphosis at T4-T6.

The true physiological kyphosis has its apex at T5
It represents the posterior junction of the two functional lordoses. Vector dominance in this segment is always toward reduction of kyphosis.

All lumbar muscles with vertebral insertion are co-agonists
In the absence of pathology, latissimus dorsi, paravertebrals, psoas, diaphragm, and quadratus lumborum all increase lordosis. Only the rectus abdominis, without direct vertebral insertion, acts as an antagonist, but remains subdominant.

Paradoxical lumbar straightening
This is the result of the exacerbation of lordosis-producing forces: horizontalization of the sacrum transforms the curve into two straight segments with an angular apex at L4-L5.

Systemic principle of compensations
Every modification in one functional unit requires adaptations in the others in order to maintain equilibrium of the segmental centres of gravity.

Disc compression produced by vector summation
Bilateral shortening of symmetrical muscles, whether anterior or posterior, modifies the physiological curves. The vertical components of their forces sum together, generating mechanical compression on the intervertebral discs, distributed in different ways according to the direction of the acting vectors.

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