The Authors

Christa Lehnert-Schroth
born 1924 in Meissen

Worked as a physiotherapist for about 50 years with scoliosis patients, using the respiratory orthopedic system developed by her mother with great success. From 1961 to 1995, Christa Lehnert-Schroth, always flanked by doctors, managed the private Katharina-Schroth Clinic in Bad Sobernheim.

In numerous lectures, articles, courses, and films for physiotherapists and doctors, as well as on exercise records for patient training at home, she demonstrated the three-dimensional scoliosis therapy, according to Schroth, for the benefit of many grateful patients and in appreciation of her mother's legacy.

Mag. Dr. Petra Gröbl
born 1968 in Graz

Studied sports science at the Karl-Franzens-University in Graz from 1986 to 1991 and then trained as a physiotherapist.

Since 2002 she has been intensively engaged in the spine's biomechanics and the functional background of scoliosis.

She regards the Schroth concept as the basis for the physiotherapeutic treatment of scoliotic patients of all ages. She teaches this concept, combined with evidence-based background knowledge, at the JOANNEUM University of Applied Sciences in Graz, Austria. Indeed, she also treats her numerous scoliosis patients according to this concept.

She sees the development of body understanding and awareness in adolescents as a particular challenge, which led to her dissertation entitled "Computer Game Supported Therapy Approach for Sports Science and Physiotherapy Scoliosis Treatment." In 2012 she was awarded a doctorate in natural sciences.

Dr. Gröbl considers a sound biomechanical understanding and a collection of specific exercises and didactic skills to maintain patient compliance to be essential for the successful treatment of scoliosis. For her, passing on the knowledge is vital. It is also an honor for her to have been involved in the redesign of this 8th edition.

Table of Contents

A Review

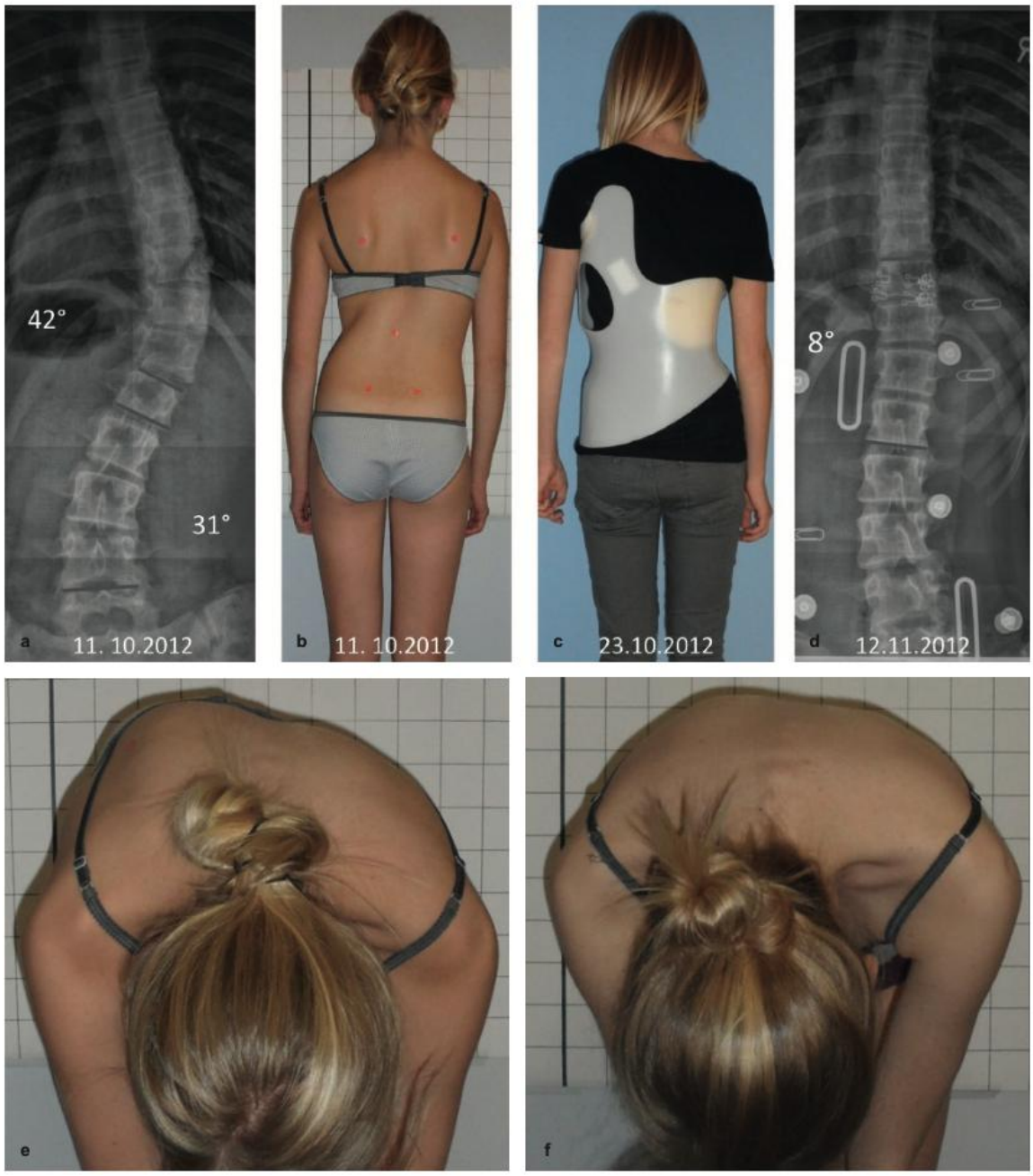


Fig. 2.4 Patient in three-curve scoliosis (G049)
a. Before wearing brace
b. Back of the patient, with markings for measurements
c. Patient in Gensingen-Brace, a modern computer scanned and designed brace
d. X-ray image. Improvements can be seen after wearing the brace for three months
e. The rib hump before treatment
f. The rib hump after wearing the Gensingen-Brace for six months

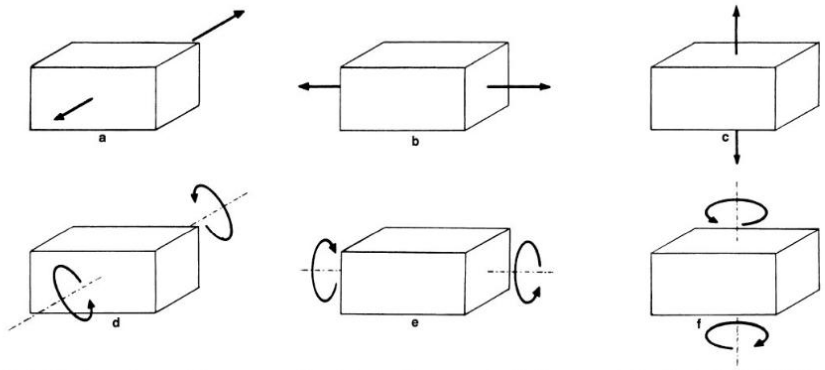


Fig. 3.2 The three main axes and the movements of the pelvis around these axes: sagittal (a, d), transverse (b, e) and longitudinal (c, f) [M616]

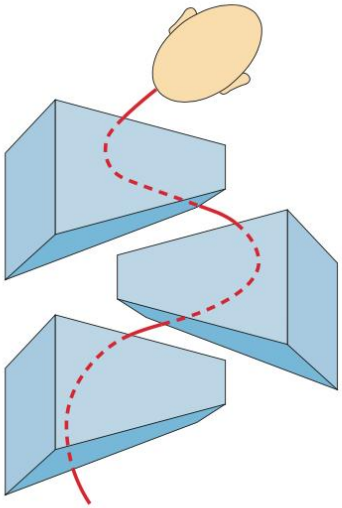


Fig. 3.3 Changes in the position of the posture in the sagittal plane: three trunk wedges [L143]

axilla (about the third ribs level) form the lower and upper borders of this section, respectively.

- Upper rectangle: the upper border is at the level of acromium, and the lower boundary is the upper border of the middle trapezoid. Cervical lordosis is not included within this segment, though functionally it is. This segment can be imagined running up to the base of the occiput. (Fig. 3.4a-c)

The body is balanced when these three rectangles are arranged vertically on top of each other when viewed frontally. However, due to the physiological curve of the spine, these segments are trapezoidal when viewed laterally, balancing over the centre of gravity. (Fig. 3.4b-c)

- In the caudal segment (trapezium a), with the pelvis in an erect position, an imaginary line which passes through both anterior superior iliac crest and extends posteriorly and horizontally to the L5 forms the lower border. The 12th ribs form the upper border.
- In the middle segment (trapezium b), which includes the chest and epigastric region, the upper border of the trapezium (a) forms the lower edge of this segment. An imaginary horizontal line forms the upper limit of this segment; it runs from the level of the cranial sternum, and passes posteriorly through the armpits, over one-third of the scapulae, up to the level of T6.
- In the upper segment (trapezium c), the upper border of the trapezium (b) forms the lower limit of this segment. The shoulder level forms its upper border. As the cervical spine is part of this segment functionally, the trapezium (c) can be imagined extending superiorly to the occiput and mandible. This extended segment is called the shoulder-neck segment.

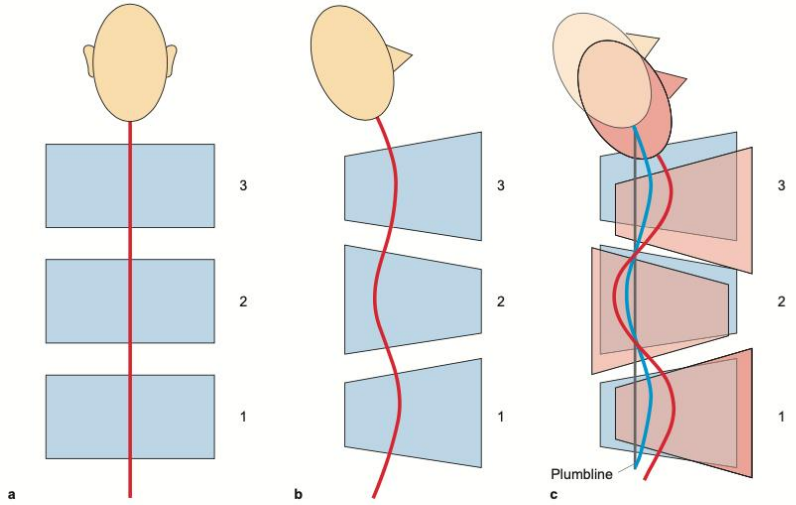


Fig. 3.4 Division of the body (schematic representation) [L143]
a. Frontal view of a healthy spine
b. Side view of a healthy spine
c. Side view of a healthy spine (background, blue WS) and a spine with postural deviation (foreground, red WS).

The three segments are in balance over the centre of gravity. In scoliosis, there are three factors to consider:

- As a result of mal-posture, the three segments deviate against each other in the sagittal plane, resulting in the formation of three 'wedges.'
- Three lateral wedges are formed because of the lateral shifting of the trunk segments. The vertices of the three wedges rotate forward while the wide sides of the wedges rotate backward, resulting in torsions of the trunk around the longitudinal axis.
- Three kyphotic convexities and three lordotic concavities are created.

It is essential to activate the three different parts of the erector spinae muscles corresponding to the trunk segments when treating scoliosis.

NOTE

The side of rib hump or convexity refers to the entire half side of the body. "Hip of the convex side" refers to the hip of the rib hump side, even when the lumbar spinal curvature is higher than that of the thoracic curve.
Likewise, the thoracic concave side refers to the other half side of the body, even though the lumbar convexity looks like a rib hump. In this situation, "the leg of the concave side" refers to the leg below the lumbar convexity.

3.2.1 Imbalance of Body Statics in the Sagittal Plane

When there is a symmetrical postural deviation in the sagittal plane or kyphosis, there will be three sagittal 'wedges' (Fig. 3.6). The wedging will be more prominent in patients with postural defects and even more in minor or major spinal deformities, for instance, juvenile or adolescent kyphosis (Scheuermann's disease) or kyphoscoliosis. In these conditions, the physiological curves of the spine will be markedly changed in the sagittal

- **4CH-scoliosis:** the prominent hip is on the side of the parcel or rib hump (thoracic convex side).
- **Exercise starting positions:** Schroth exercise has three typical starting positions: prone, supine, and side-lying in order. These positions are based on the classification of scoliosis and basic correction principles.
- **Shoulder parcel (shoulder convexity):** a prominent cervicothoracic curvature

Clinically, the shoulder block that rotates a lot is higher on the weak side. The shoulder rotates posteriorly, narrowing the clavicle in front. Thus, during inhalation, this part and the narrowed anterior chest on the side of thoracic convexity need to be inflated simultaneously. Shoulder parcel is a common compensation of the thoracic convexity. The simplest correction is to carry a schoolbag on the shoulder of the convex side.

3.3.2 Scoliosis Patterns

The rectangular blocks are normally stacked vertically on top of each other. In scoliosis, these blocks shift and rotate against each other, resulting in the formation of 'wedges.'

Three-Curve Scoliosis

In three-curve scoliosis, the shoulder and pelvic blocks shift to the same side in the frontal plane and the thoracic block to the opposite side. These laterally translated blocks rotate posteriorly simultaneously, as shown in Fig. 3.9.

3C Scoliosis (3C)

3C scoliosis is a major thoracic curvature with lumbar and shoulder-neck compensation curvatures. There are no translations of the pelvis and no hip prominence. In most cases, the pelvis is not rotated, nor laterally tilted. The trunk will translate towards the thoracic convexity, while the loading on the leg and the static body force will tend to shift to the thoracic convex side.

Major curvature: thoracic convexity

Typical characteristics: thoracic convexity (rib hump) and weak side

Three-Curve Scoliosis with Hip Prominence (3CH)

The 3CH scoliosis is a statically decompensated thoracic scoliosis. The pelvis shifts laterally to the weak side (prominent hip). Also, it moves laterally (translates cranially), and rotates posteriorly on the side of thoracic concavity. As a result of the lateral displacement of body blocks, there is a significant change in body statics. ; the thoracic block translates to the side of thoracic convexity, and the lumbar/pelvic block translates to the weak side, with increased load on the leg on the side of thoracic convexity.

Major curvature: large thoracic curvature

Typical characteristics: the distinctive parcel and weak side, prominent hip on the weak side.

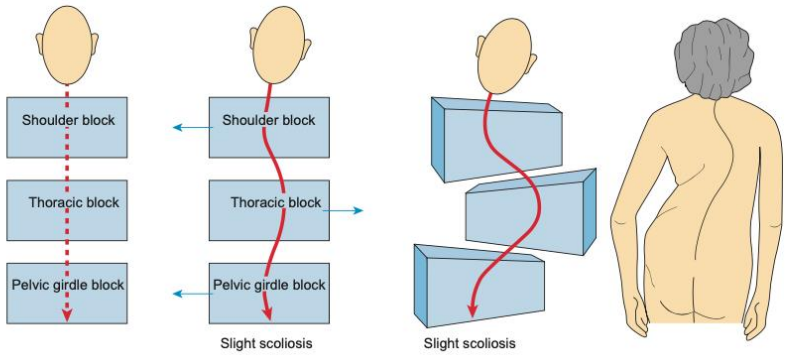


Fig. 3.9 Three-curve Scoliosis: postural deviation in the frontal plane [L143]

Four-Curve Scoliosis

The term 'four-curve' was used because the four body blocks shift against each other and deviate the spine to one side. The pelvic alignment and defect in body statics are notably different from three-curve scoliosis; hence it requires a different treatment approach.

4C Scoliosis (4C)

In most cases, this is true double-major-curvature scoliosis. Both curvatures are structurally distorted. Statically, the body tends to decompensate towards the weak side of the thorax, although it still looks balanced in many cases. In the coronal plane, the pelvis is usually balanced without significant hip prominence.

Major curvature: thoracic and lumbar

Typical characteristics: lumbar hump, weak spot, thoracic convexity, weak side.

Four-Curve-Scoliosis with Hip Prominence (4CH)

In scoliosis with lumbar or thoracolumbar curvature, the hip is usually prominent on the thoracic convex side. The pelvis rotates in the opposite direction to the lumbar curvature (rotate posteriorly on the thoracic convex side). Further, it is tilted superiorly on the thoracic convex side. The trunk is translated towards the weak side, and the load on the leg on the weak side increases. The thoracic and shoulder-neck curvatures are usually the compensating curvatures, rather than structural scoliosis, and are more mobile. Sometimes the body looks quite symmetrical.

Major curvature: lumbar (apical vertebra at L2) or thoracolumbar (apical vertebrae at T12 and L1)

Typical characteristics: lumbar hump, weak spot, prominent hip on the thoracic convex side.

3.3.3 Disease Pattern in Sagittal Plane 1 (M1)

Postural defects in the sagittal plane, thoracic (lumbar) Scheuermann's disease, thoracic or lumbar kyphosis, and flat back.

Common Terminology

- Neutral vertebra: the upper or lower end-vertebra of scoliosis. Features: the vertebral body is located relatively medially, which is the most inclined, with the least rotation, and only slight structural changes (the upper and lower vertebral endplates are parallel). The neutral vertebra is the transitional point between the thoracic and lumbar convexity, which is used in X-ray imaging to describe the body statics. When measuring the Cobb angle, the upper and lower endplates of the neutral vertebra can be used as a reference point.

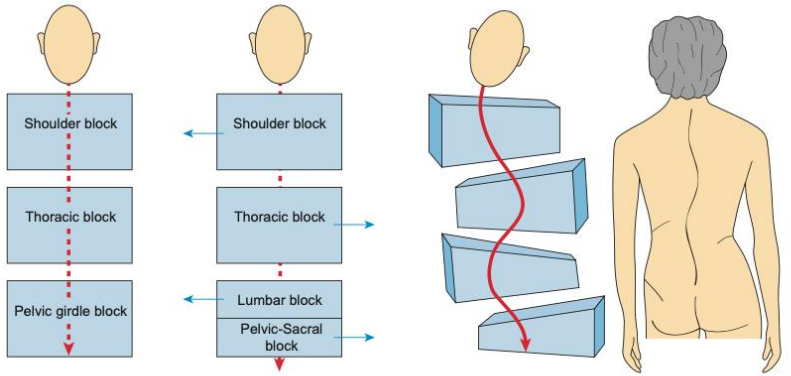


Fig. 3.10 The trunk is divided into three imaginary 'blocks' that shift and turn against each other in scoliosis. In the case of four-curve scoliosis with an additional lumbar curvature, the pelvic block is further divided into lumbar and pelvic blocks (right). The thoracic block shift laterally and dorsally. The lateral shifted trunk areas are turned backwards simultaneously, as indicated in this diagram. [L143]

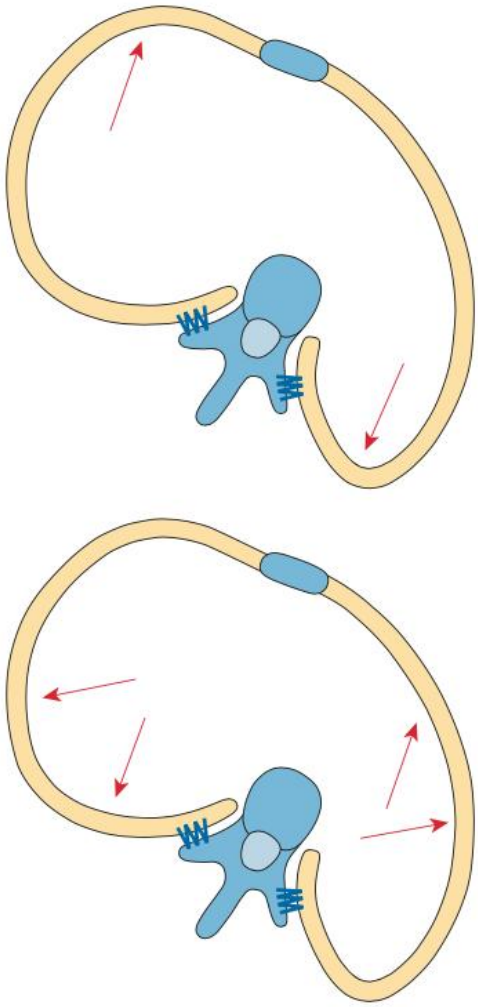


Fig. 4.4 Rotational angular breathing (RAB)
Left: Scoliotic breathing pattern. The scoliotically deformity in the thorax is shown in transverse section. The torsion is increased by the scoliotic breathing pattern. The arrows indicate the direction of breath in idiopathic scoliosis.
Right: Corrective breathing pattern according to Schroth. The arrows indicate the direction of RAB. [L143]

a deep breath symmetrically, not in a specific direction, more air is directed to the already stretched and prominent rib hump side. Symmetrical breathing increases the scoliotic deformities, as it does not have the corrective moment of elongation and derotation.

4.1.3 Rotational Angular Breathing / Right-Angled Breathing Pattern (RAB)

RAB is a conscious and directional three-dimensional breathing pattern. The breathing is directed at specific directions, including anteriorly, posteriorly, laterally, cranially, or caudally. By RAB, the patient always leads the breath into concavities (vertices of the wedges) and consciously flattens the diaphragm:

- Convex side (Right): floating ribs laterally and superiorly, and posteriorly and superiorly
- Concave side (Left): laterally and superiorly, and posteriorly and superiorly
- Anterior convex side (Right): anteriorly and superiorly
- Subaxillary ribs on the convex side (Right): anteriorly and superiorly, with counter-traction of right shoulder, laterally superiorly and posteriorly (Fig 9.16c). The shoulder girdle rotates against the thoracic spine.

Therefore, if the breathing pattern in a scoliotic patient can be changed, each breath acts as a corrective exercise. Contracting the trunk muscles on the side of scoliosis convexity limits the breathing excursions on the same side. The muscle contraction, however, increases the breathing excursion on the side of concavities. Patients can be trained in RAB, which forms the fundamental basis of the Schroth method.

NOTE

However, RAB should only be applied when the trunk is elongated, and the concavities are relieved of pressure. The patient is hence required to straighten the spine first to reduce the passive restraint from the ligaments within the existing range of spinal mobility.

Scoliotic patients must learn how to correct their breathing pattern by consciously directing breathing into the concavities of the rib cage to improve the mobility of the restricted ribs and fill the less ventilated parts of the lungs to facilitate the correct posture. The contraction has to be on the side of convexities to prevent an increase in prominence. Breathing has to be directed to the concavities. The benefits of the alteration of the breathing pattern of a scoliotic patient can be demonstrated by scoliometer measurements (Weiss, 1989; Ch. 11.3).

The breathing movement values of several patients were measured with Heibrock-Seift Method. The intervention is a 5-week course in-patient treatment (Ch. 11.4). Values were recorded at baseline at the beginning of the treatment sessions. Tape measurements of the following regions were taken at deep inhalation and exhalation:

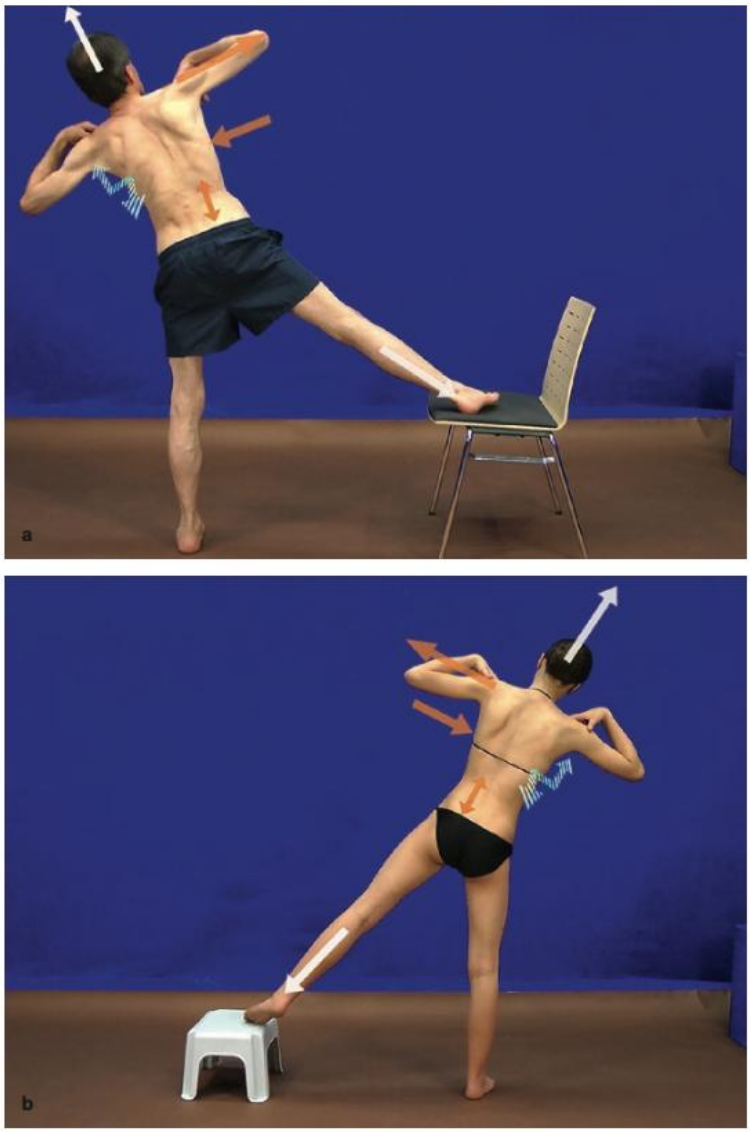


Fig. 9.5 Muscle cylinder exercise in standing position (for explanation of the arrows, please read the users' manual) [W858]
a. Right thoracic scoliosis
b. Left thoracic scoliosis

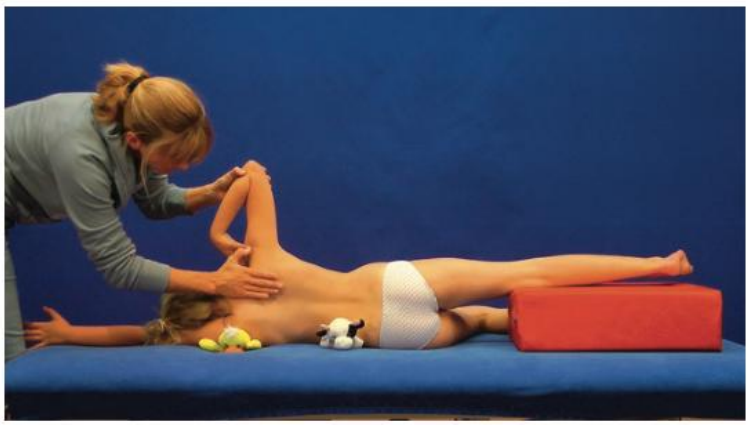


Fig. 9.6 Muscle cylinder exercise in side lying position, use hand for stimulation [W858]

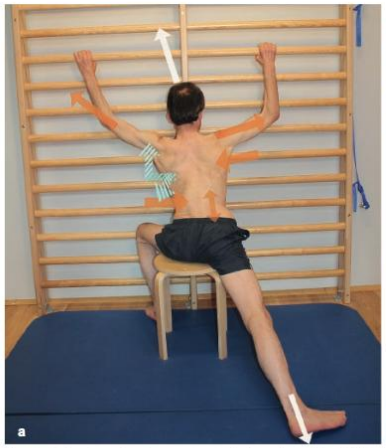


Fig. 9.10 Rotational sitting exercise: right thoracic scoliosis [W858]
a. from posterior (for explanation of the arrows, please read the users' manual); b. from posterolateral

9.2.2 Rotational Sitting Exercise

NOTE

This exercise can influence all segments correctively (Omit in the case of four-curve scoliosis). (Fig. 9.10a, b)

- Sit on a chair. Extend and externally rotate the leg on the thoracic convex side, so the instep of the foot touches the floor. This heel pushes backward and downwards.
- Bend the other knee in the front to form a right angle —lean upper body forwards (but not bending!), forming one line with the extended leg. The weight of the body rests on the hip of the concave side.
- A cushion in front of the hip on the convex side (= all five pelvic corrections!).
- Shift the upper body obliquely to the concave side, to strengthen the inactive muscles below the thoracic convexity.
- Tilt the head to the left (= a compensation for cervical scoliosis), and rotate the chin to the convex side (= activating unilateral weak neck musculature - intensified by weight carrying activity). The movement derotates the cervical spine.
- It shows clearly how far the lumbar spine has shifted from the midline. During exercise, the lumbar spine approaches the midline, which activates the lumbar segment of the erector trunci.

Fig. 9.11 shows a very severely stiffened 24-year-old female patient with marked atrophy at the front, sides, and back of the left side. The sharp rib hump pushes the right lumbar muscles and the free ribs so that it forms a deep furrow. Fig. 9.12a, b, and Fig. 9.13 shows the success of the treatments.

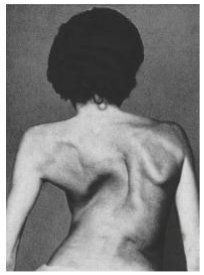
ATTENTION

Shoulder Girdle

During these exercises, always shift the trunk towards the concave side to widen or open the area. The left truncal shifting has the danger of pulling with the shoulder on the concave side. The translation of the shoulder is not necessary and, in most cases, even wrong. Forced lifting of the shoulder girdle will create a cervical curve automatically.

The concavity is widened by breathing into it and keeping the width by isometric tension. During the rotational sitting, after correcting all three truncal segments, use the arm on the concave side to push against the back of the seat or a table. Do not lift the left shoulder, but bring it forward actively. RAB moves the concave ribs apart and backward and upwards, and this raises the shoulder. This way, they form a holding and a supporting posterior wall.

The muscle on the concave side must be first elongated, then activated forcefully. On the convex side, force the latissimus dorsi to contract together with the serratus lateralis muscle. The correction is only possible after correcting the torsions of the three trunk segments.



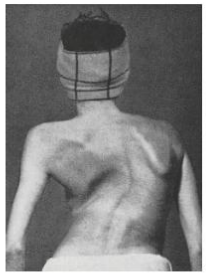


Fig. 9.11-9.13 Severe scoliosis in a 24-year-old female patient with very restricted movement and VC. [M616]
Fig. 9.11 (Left) Before treatment
Fig. 9.12a (Mid-left) After 3 times of 3-month-treatment
Fig. 9.12b (Mid-right) After the 4th treatment
Fig. 9.13 (Right) During 5th treating, rotational sitting exercise, with mirror control

9.2.3 On All Fours

This exercise is based on the functional gymnastics of Klein-Vogelbach and is commonly used in Schroth exercises (Fig. 9.14a, b).

9.2.4 Exercise: Small Cranial Oscillatory Movements Upwards Between Two Poles

- Sit on ischial tuberosities. (Fig. 9.15, Fig. 9.16). Use corrective cushions if necessary.
- The upper body leans forward and sideways towards the concave side. Straighten the patient's spine by continuous small wriggling movements, since a derotation of individual rotated trunk segments is only possible after straightening the trunk.
- Maintain the corrected position of the shoulder girdle, and push the poles onto the ground. The oscillatory movements upwards to straighten the back have to be slow and allow an intense concentration on the concave areas of the trunk.
- Only after this can RAB exercises begin. During exhalation, the isometric tension and muscle mantle can then stabilize the results. The position is then correct for the next inhalation. The second side of the 'right angle' breathing always runs cranially to lengthen the spinal column maximally. Additionally, an occipital neck elongation increases the straightening effect.

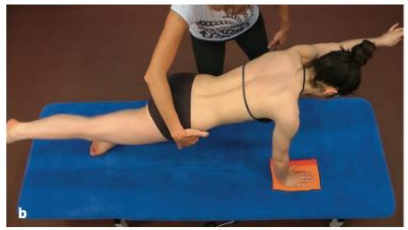


Fig. 9.14 On all fours [W858]
a. Suitable for children
b. Correct pelvic position