PHYSIOTHERAPY FOR SCOLIOSIS PATIENTS FOLLOWING SPINAL FUSION SURGERY

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Summary

Scoliosis patients who have undergone surgery for spinal fusion commonly believe that they no longer have any need for physiotherapy. This is often incorrect because the non-fused spinal section as well as the associated trunk segments can easily slip back into a scoliotic pattern in the event of poor posture or incorrect movement. It is therefore vital for patients to be taught specific exercises that will correct their posture and maintain stability above and below the fused spinal segment.

Introduction

Scoliosis patients who have undergone surgery for spinal fusion often think that they can manage without a physiotherapy exercise programme. However, this attitude is not entirely correct. Below and above the fused segment there are mobile spinal segments that are often overloaded. This situation can lead to pain. Of course, care must be taken not to mobilise the fused spinal segment so as to avoid loosening the implant. Nevertheless it is necessary to perform postural correction exercises in order to stabilise the non-fused spinal segments.
Spinal fusion may be followed by loss of correction that can be largely offset by appropriate exercises. Scoliotic postural and movement patterns persist in the consciousness of patients who have undergone surgery for spinal fusion. These patterns are not suddenly corrected as a result of surgery. If they are not modified by specific postural training, they continue to affect the balance of forces in the trunk. Correctional losses following spinal fusion are probably also attributable to this circumstance in some cases.

Before physiotherapy is started, the following questions must be clarified:
- How long is the fused segment and hence how much mobility remains?
- Is the fused segment capable of withstanding exercise and loading?
- Is pain present, and if so, what is causing it?
- Does the patient have any impairment of cardiovascular function?
- Does the patient have any impairment of respiratory function (vital capacity, rib cage mobility)?
- Does the patient understand the implications of any action or failure to act?
- Is the patient motivated to be proactive after surgery for spinal fusion?
- What is the patient's occupation?

It must also be remembered that the tendencies and habits of the individual will have an effect on physiotherapy. Patients who enjoy movement and exercise will often have to be held back in their activities whereas others will need to be encouraged to do something for themselves.

However, the overriding motto must always be: Do no harm!

Goals of treatment

The goals of treatment are identified on the basis of assessment findings in each individual case. An individual assessment must therefore be made that will enable a treatment plan to be formulated. Five main areas will be outlined here:

1. As a result of surgery for spinal fusion, the costovertebral joints will also be involved, causing limitation of rib motion. The entire thorax will appear rigid – and so it is in reality. It is therefore extremely important to increase the limited rising and lowering motion of the ribs. Of course, the movements of respiration must be used specifically in this process.
The pulmonary regions of the scoliotic trunk that are already better ventilated are filled anyway during 'normal' deep breathing that does not focus on correction and diaphragm motion. The concave areas (sites of narrowing in the trunk) remain inactive. This must be drawn to the patient's attention so that he or she can learn to direct respiratory movement into the concave areas of the trunk. This increases vital capacity, oxygen uptake and patient well-being. To achieve this, the therapist must supply respiratory stimuli and verbal correction. The inhalation phase is always used for correction whereas the exhalation phase is used to stabilise the correction achieved.

2. The hypermobile spinal segments above and below the fused segment must be stabilised to prevent progression of deformity and, especially, pain.
Patients often believe that now they no longer have to do anything at all for themselves because the surgeon has done the work for them. However, this is erroneous thinking. As far as the future is concerned, patients must not fall back into their habitual curvature pattern because the still-mobile segments of the spine will give way and the formerly vertical rod will lean to one side (**Figure 1**).

Figure 1
17-year-old youth with thoracic scoliosis and convexity on the left side. Surgical fusion (Harrington procedure) of the upper thoracic spine as far as L1. The left-hand photo illustrates a subconsciously assumed, comfortable posture that brings the upper body together with the Harrington rod into a left oblique position. The pelvis deviates to the right and twists to the right and backwards.
This torsion produces narrowing of the concavity on the right side.
The right-hand photo illustrates the conscious elimination of this incorrect posture, with the Harrington rod now sitting vertically.

3. The imbalance of forces often encountered postoperatively needs to be reduced in a functional manner. This is why patients who have undergone surgical fusion also need to watch their posture and maintain appropriate function in those skeletal parts that are still mobile. Habitual sitting and standing postures need to be reviewed. When we recall how often and for how long people sit each day, it becomes clear that poor sitting posture cannot remain without adverse consequences.

Patients often need a forearm support at table for the collapsed concave side, also during school- and work-related activity and while watching TV.

4. The muscular imbalance needs to be minimised by strengthening weak, inactive muscles.

5. The corrective movements need to become instinctive and should be integrated into daily movement routines. Contraindications to certain measures also need to be identified and taken into account. The only person who can provide information about this is the surgeon with overall responsibility. To avoid implant loosening, passive traction by manual or mechanical methods should not generally be used. For the same reasons, jarring of the spinal column must be avoided as far as possible – but generally during the first postoperative year as a minimum.

Basic principles of physiotherapy in the management of scoliosis

When using physiotherapy in the management of scoliosis it should be recalled that the condition entails a three-dimensional deformity of the spinal column. According to Schroth, the trunk is subdivided into three blocks, positioned one above the other. In the scoliosis patient these blocks are not only mutually displaced laterally, but they are also torsioned against each other (**Figure 2**).

Based on clinical considerations, the scoliotic deformity requires caudal-to-cranial correction to the full extent that structural changes permit. Physiotherapy is therefore primarily directed at postural correction of the curvature. This means that all spinal segments should undergo the most extensive caudal-to-cranial correction possible within the framework of any residual potential for postural modification.

All curvatures are to be addressed in this process. In broad terms a distinction is drawn functionally between 3-curve scoliosis (**Figure 2**) and 4-curve scoliosis (**Figure 3**) with a compensatory lumbosacral curve.

In this case we refer to '4-curve' scoliosis because the lumbar-pelvic block is displaced and torsioned within itself and the spine forms an additional curve.

Pelvic corrections

To counteract the abnormal position of the pelvis due to scoliosis, the following corrective pelvic exercises are performed to correct the region of the lumbar spine, pelvis and hip:

1. Moving the pelvis backwards causes the upper part of the body to move forwards, resulting in activation of posture.

Figure 2
Conceptual subdivision of the trunk in a patient with 3-curve scoliosis with thoracic convexity to the right: the three blocks, positioned one above the other, are mutually displaced laterally with torsion.
The laterally deviating segments are simultaneously rotated dorsally. The patient's body weight is resting on the right leg.

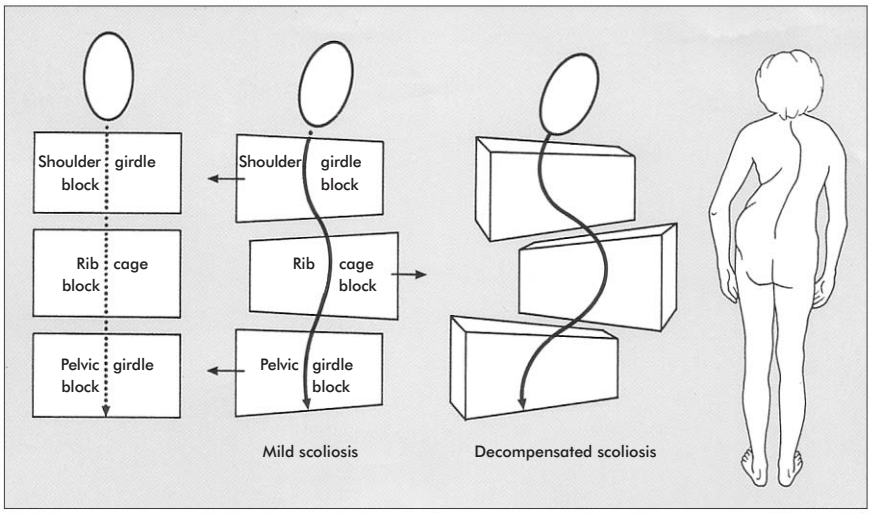
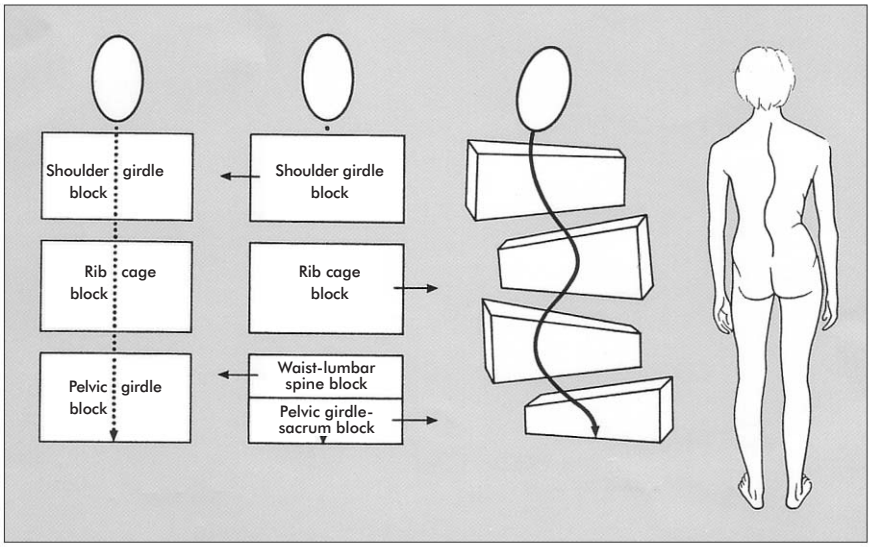


Figure 3
Conceptual subdivision of the trunk in a patient with 4-curve scoliosis with thoracic convexity to the right and a compensatory lumbosacral curve. The pelvic girdle block is further subdivided into a lumbar section and a pelvic section. The laterally deviating segments are simultaneously rotated dorsally. The patient's body weight is resting on the left leg.



2. Elevating the anterior pelvic border (= the *spinae*) produces slight opening of the facets in the lumbar region as a prelude to further corrections. Where 4-curve scoliosis is present, there is often an excessively large lumbar hump, in which case this pelvic correction should be omitted.

3. In functional 3-curve scoliosis the pelvis, which is usually prominent on the side with the thoracic concavity, is corrected inwards. This is then simply followed by continuous corrective movement of the upper body by inclining (not bending) the trunk laterally towards the side with the thoracic concavity. This has to be widened out in the process. If the patient has a prominent hip on the rib hump side, as is the case in functional 4-curve scoliosis, the lumbar hump first has to be derotated against the pelvic segment. The pelvic torsion almost invariably present in this case can be monitored and corrected among other things by external rotation of the leg on the concave side. If the fused segment extends as far as the sacrum, these corrections are of course not possible.

A spinal operation cannot take account of this situation because during the surgical procedure just one spinal segment (of varying length) is fused. In most cases the pelvis remains free. If patients do not pay attention to their pelvis and allow their upper body to slip laterally, the entire fused

segment also tends to incline to one side. Discomfort ensues at the caudal end of the fused segment. However, because the head strives to return to the middle, it is not uncommon for the curvature in the upper thoracic and cervical spinal segments to become larger. This active correction is therefore also important.

4. As a fourth pelvic correction, the pelvis is derotated in the transverse plane. Care must be taken to ensure that the higher trunk sections do not make any 'escape' movements.

5. The fifth pelvic correction is performed with the patient standing and involves isometric pressure with the foot on the rib hump side against the floor to provide additional pelvic corrective tension. Patients who have undergone surgery for spinal fusion can easily perform these corrective exercises.

Postural correction of the rib cage and cervical spine in conjunction with breathing

Once the lower extremities and pelvic position have been corrected, the pelvic block may serve as a fixed point for the corrections to be performed cranially. However, corrective breathing can only be effective if space has been created for respiratory excursion. Where the trunk has become concave, breathing movement cannot bring about the correction. Therefore active stretching of the trunk is first performed as auto-elongation – not to be confused with hyperextension in the thoracic spine. This active stretching movement of the trunk is also possible following spinal surgery.
After the active elongation phase, the breathing movement is guided into the concave areas of the trunk. This happens by imagining unilateral breathing. Tactile stimuli are helpful here: initially these are given by the therapist, but later also by the patient himself or herself.

In cases of pronounced deformities with a markedly collapsed concave side, external aids are used initially for postural training. For example, the arm on the patient's concave side can be placed on the backrest of a chair positioned sideways on; this causes widening of the concave side.
Appropriate starting positions can be maintained while watching TV or at mealtimes.
In functional 3-curve scoliosis, the hip on the rib hump side may protrude beyond the seat outwards, backwards and downwards, causing the concavity beneath the rib hump to widen further. This results in 'oblique traction' through the entire upper body as a corrective direction for the rib hump that has fallen away laterally (**Figure 3**). We do not use this exercise for patients with a compensatory lumbosacral curve because in such cases there is already a tendency for the hip beneath the rib hump to protrude laterally. These patients load both tuberosities equally.
During postural correction 'occipital pushes' are performed with the head as an extension of the thoracic spinal curvature. During torsion of the cervical spine or of the cervicothoracic junction, the chin is also turned slightly towards the rib hump side. Purpose: derotation of the cranial spinal curve.

These corrective exercises can easily also be performed by patients who have undergone surgery for spinal fusion. Isometric stabilisation occurs during the exhalation phase, with the added assistance of small intermittent movements of the trunk in a sagittal plane designed to cause reflex activation of the postural muscles of the trunk.

Each exercise is performed with targeted breathing (= rotational angular breathing) that is 'guided' into the corresponding areas of concavity. As mentioned above, isometric tension of the trunk muscles in their corrective position occurs principally during exhalation.

Exercise examples

To avoid loosening or dislocating the implants, free-hanging wall-bar exercises are not used in patients who have undergone surgery for spinal fusion.

Wall-bar exercises are important for stabilising the entire body (**Figures 4 – 8**).
The same is true for exercises performed with aid of a chair or stool; these are illustrated in **Figures 9 – 13**.

In our clinic we have numerous mirrors attached to the ceiling. At home the patient can place a light mirror (foil mirror) over the back-rests of two chairs. He or she can then adopt a supine position between the chairs and under the mirror and thus monitor what is being achieved during exercise. This is especially important for the isometric type of exercise because only the intended muscles should be working. This can be seen precisely in the mirror.

If the exercise programme is implemented as described, nothing can happen to the implant. We have never yet had any adverse experiences.

All the exercises described are also possible if the patient is wearing a brace. They can also be used for stabilisation in patients with intervertebral disc injuries.

Figure 14a shows a woman who had undergone surgery for spinal fusion and with a certain imbalance of the forces acting on her body. Her lower abdomen protrudes further than her thorax. Because her body axis is interrupted at several points, her appearance is characterised by increased lumbar lordosis and a rib hump with posterior overhang, which appears even larger due to the forward tilt of her head.

Figure 14b shows that postural correction can also be achieved in patients who have undergone surgery for spinal fusion. By using the first two pelvic correction exercises the patient has also become more upright in the trunk section above, and even the rib hump appears smaller as a result.

Figure 4
Sitting cross-legged in front of wall-bars. Pulling with arms on a bar brings the upper body closer to the wall-bars. The body weight is on the left side in 3-curve scoliosis, and on both buttocks in 4-curve scoliosis. After rotational angular breathing, the patient 'pulls down' on the bar while exhaling.

Figure 5:

Left-hand photo:
After rotational angular breathing, both fists are pressed against the floor to strengthen the lateral longitudinal muscles during the exhalation phase.

Right-hand photo:
Same intended effect, but here using two poles and pressing the head against the wall.

Figure 6:

Standing in front of wall-bars, with arms above head height and spread wide to take hold of bar. First the pelvic corrections. During rotational angular breathing and auto-elongation, the upper body is lifted out of the 'funnel' of the pelvis. The concave trunk sections are widened posteriorly. During exhalation, muscle mantle tension in the corrected position. Also contractile tension of the abdominal muscles.

Figure 7:

'Cross of St. Andrew' (for 3-curve scoliosis only!). Standing, with concave side towards the wall-bars. The patient takes hold of a bar well above head height. Both feet remain on the floor, and the right foot is moved cautiously away from the wall-bars. The concave side is widened using rotational angular breathing. After correction during inhalation, isometric muscle mantle tension is performed to consolidate what has been achieved.

Figure 8 (Right-hand)
Kneeling in front of wall-bars.
Rotational angular breathing.
During exhalation, isometric tension is performed with imagined resistance (pelvis against head and arms).

Figure 9:
Sitting upright on a chair. Both elbows are raised high, thus stretching the collapsed areas. The upper body is inclined to the side of the thoracic concavity (without narrowing this costal region!).
With the upper body leaning forward slightly, the right-sided lumbar erector muscles are exercised, so helping to contract the rib hump.

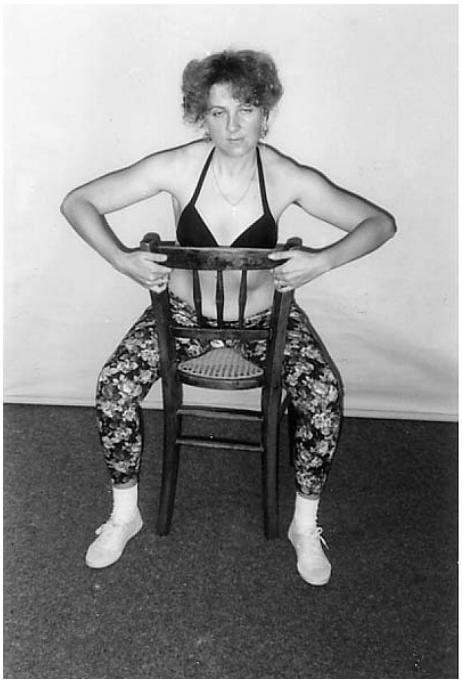


Figure 10:
Isometric arm exercise on a chair, sitting straddled with back-rest in front. Positioned well back on the chair, the patient takes hold of the back-rest as illustrated. During the exhalation phase the patient pulls outwards on the back-rest (left-hand photo: kyphotic back) or presses inwards on the back-rest (right-hand photo: flat back).

Figure 11:

Left-hand photo:
Expanding the thoracic muscles on the rib hump side. With the arm gripping firmly behind the back-rest, the rounded upper part of the shoulder girdle is tilted backwards. Against this, the narrowed thoracic side seeks to move forwards and upwards.

Right-hand photo:
The same exercise using a cupboard or wall-bars. Here the concave side needs to be broadly supported so that derotation of the trunk can become effective. Rotation is performed as follows: pelvis on right side backwards, thorax on right side forwards, shoulder girdle on right side backwards. And all this with 'isometric muscle contraction' with the prominent hip.

Figure 12:
Isometric arm exercise.
Supine on corrective support cushions, with hands holding a footstool placed above the head, as shown.

To strengthen the muscles of the arms and trunk, the patient:
(a) presses inwards on the footstool (for flat back);
(b) pulls outwards on the footstool (tendency to kyphosis);
(c) presses it against the floor to flatten the upper rib hump; or
(d) raises it a little to strengthen the thoracic and abdominal muscles.

This strengthening exercise is performed principally after rotational angular breathing correction.
Always avoid straining!

Figure 13:
Isometric leg exercise.
Supine on corrective support cushions, with footstool placed at the feet, knees flexed with feet on floor.
After correction during inhalation the patient:
(a) presses inwards on the footstool with feet outside while performing 'isometric muscle contraction' with the abdominal muscles;
(b) presses outwards on the footstool with feet inside, keeping the lumbar region largely on the floor;
(c) places feet on the footstool and presses down on it; or
(d) places feet under the footstool and raises it.

Figure 14 a + b

See text for explanation.