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Original Article

Reliability of the original Lehnert-Schroth (LS) scoliosis classification in physiotherapy practice

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Abstract. [Purpose] The foundations of the scoliosis specific and evidence-based physiotherapy program according to Schroth is the original the Lehnert-Schroth (LS) classification which is still in use today. The purpose of this paper is to test the reliability of the LS classification system, using clinical and radiological images of scoliosis patients as classified by specialist experienced clinicians. [Participants and Methods] A list of 40 pictures of X-Rays and a list of 40 clinical pictures (all posterior trunk images) of patients with idiopathic scoliosis were provided by the second author. Three specialist professional physiotherapists or orthotists rated all clinical and radiological pictures according to these two patterns of the LS classification. [Results] The intra-observer Kappa value was 0.90 (clinical) and 1.00 (x-rays). The inter-observer Kappa values at average was 0.65 (clinical) and 0.71 (x-rays). [Conclusion] For the application of classifying the patients when prescribing postural advice and exercises from the Schroth program the LS-classification seems an easy to use and highly reliable tool. This test demonstrated sufficient reliability with respect to the x-rays, but the tests of the clinical pictures alone, demonstrated fair levels of reliability, which indicates that it is an appropriate tool for physiotherapists when an x-ray is not available.

Key words: Scoliosis, Physiotherapy, Classification

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INTRODUCTION

Scoliosis—as a three-dimensional deformity of the spine and trunk—is not a uniform condition and may have different causes (e.g. congenital, neuromuscular, other rare diseases). The most common cause is the adolescent idiopathic scoliosis (AIS) with 80−90% of all scoliosis conditions[1–3)].

Treatment of scoliosis consists of physiotherapy, brace treatment and spinal fusion surgery. While there is high quality evidence for specialist physiotherapy[4–7)] and brace treatment[8–12)] evidence for surgery is still lacking[13–18)]. During the pubertal growth spurt, patients at higher risk for the scoliosis to progress, bracing is the primary treatment supported by physiotherapy, whilst in patients with a lower risk of progression, physiotherapy can be considered the primary choice of treatment[3, 6)].

Today there are many different approaches of physiotherapy suggested for the treatment of signs and symptoms of scoliosis[6)], however, high quality evidence has been obtained for the Schroth method only, with a randomized controlled study providing a comparative untreated control group[7)]. Besides its impact on the angle of curvature (Cobb angle) the Schroth method may improve many other signs and symptoms of a scoliosis. Vital capacity, right cardiac strain, muscle endurance and pain can be improved, besides quality of life and other psychological parameters[6)].

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The original Schroth method first started in 1921 on an in-patient basis and has since been developed further[3, 19]. While the original Schroth method program was mainly used for large single thoracic curves (over 60 degrees Cobb angle at diagnosis) in the late 1970s the intermediate development also included major lumbar curvatures and this was the beginning of the pattern specific physiotherapy treatment of scoliosis and the separation of 3 and 4 curve classification patterns[3, 19]. Lehnert-Schroth termed the major thoracic curves (functional) 3-curve patterns (3C) and the major lumbar and double major curves (functional) 4-curve patterns (4C)[3, 19, 20].

The most recent development of the Schroth method today is the Schroth Best Practice program[3], also including corrections of the sagittal plane deformity as well as the original augmented corrective movements and pattern specific activities of daily living (ADLs) starting with the first publications in 2006[21, 22]. This more recent development also encompasses the simple Lehnert-Schroth (LS) classification distinguishing between 3C and 4C patterns[3].

Some other classifications have been developed since the 1980s supporting pattern specific approaches of surgery[23, 24] and brace treatment[3, 25–27], however for physiotherapy treatment of an idiopathic scoliosis the LS classification with these two distinctive patterns is the most simplified version and is still used worldwide today[3, 19]. The purpose of this paper is to test the reliability of the LS classification with respect to the clinical and the radiological aspects of scoliosis patients.

PARTICIPANTS AND METHODS

Description of the LS-classification: According to Schroth terminology[3, 19], pattern specific physiotherapy needs to distinguish between 'functional 3-curve scoliosis' and 'functional 4-curve scoliosis', for it be specific (Fig. 1). With functional 3-curve scoliosis, the shoulder-neck section, the thoracic section, and the lumbo-pelvic section are twisted and askew in frontal, sagittal, and transverse planes (Fig. 2).

With functional 4-curve scoliosis, the lumbo-pelvic section is further subdivided into a lumbar section and a pelvic section, with the pelvis being seen as an additional functional curvature that serves as a starting point for an independent correction principle in the context of the tailored physiotherapeutic treatment (Fig. 3). With functional 3-curve scoliosis we distinguish between scoliosis with a laterally prominent pelvis on the thoracic concave side (=3CH) and functional 3-curve scoliosis and a centred pelvis (=3C; Fig. 2).

Functional 4-curve scoliosis is distinguished by the prominence of the hip on the thoracic convex side (=4C; Fig. 3). Typically, there is a structural lumbar or thoracolumbar curvature and the lumbar spine proceeds from the sacrum in an oblique movement, also known as 'oblique take off'[28].

Methodology: 40 different AIS patients were selected from the database of the second author. Provision of (a) the clinical pictures of all the patients (posterior trunk views) and (b) the X-Rays of these patients on a PDF without any identifiable markings and these were then numbered consecutively. The participants were selected with the following inclusion criteria: Adolescent idiopathic scoliosis (AIS), Age 12−16 years, Cobb angle between 35 and 50° Cobb.

Both lists included both curvature types. X-Rays and clinical pictures were numbered in a different order to avoid the professionals involved drawing conclusions from the X-Ray when rating the clinical picture or vice versa.

Clinician MB (specialised physiotherapist and orthotist) rated all clinical and radiological pictures twice without access to the previous ratings in order to determine the inter-rater reliability of the classification.

Clinician XFN (specialised orthotist) and clinician DT (specialised physiotherapist) rated all clinical and radiological

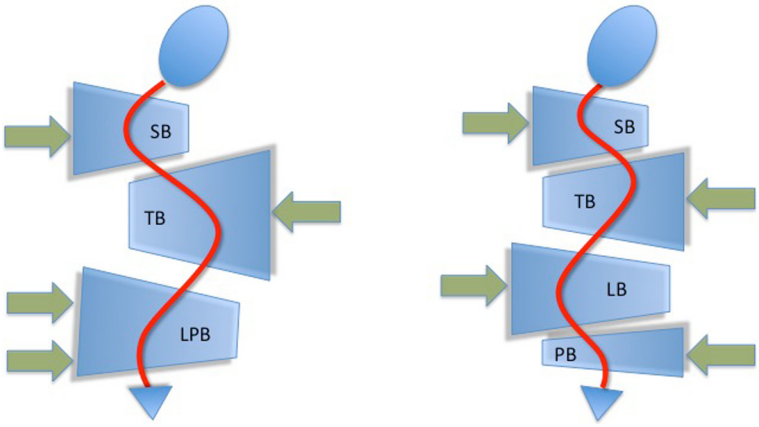

Fig. 1. The LS-Classification. On the left the typical 3C scoliosis with three blocks deviated and rotated against each other. On the right the typical 4C scoliosis (double major) with four blocks deviated and rotated against each other. The arrows indicate the frontal plane correction of the blocks against each other (courtesy of the Schroth Best Practise academy with kind permission).
SB: shoulder block; TB: thoracic block; LPB: lumbopelvic block; LB: lumbar block; PB: pelvic block.

pictures once in order to determine the inter-rater reliability of the classification with respect to clinical and radiological views. Their results were also compared to the first rating of clinician MB.

Intra-observer (performed by MB) and inter-observer Kappa values (performed by MB, XFN, DT) were calculated for this classification with respect to the clinical answers, as well as the radiological answers.

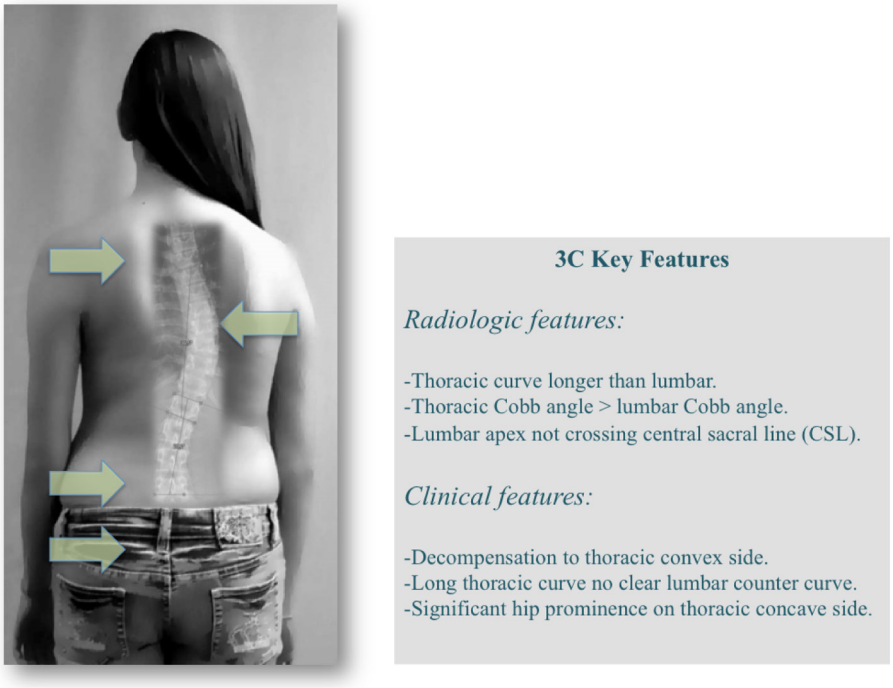

Fig. 2. Key features of the functional 3C pattern according to Schroth (courtesy of the Schroth Best Practice academy with kind permission).

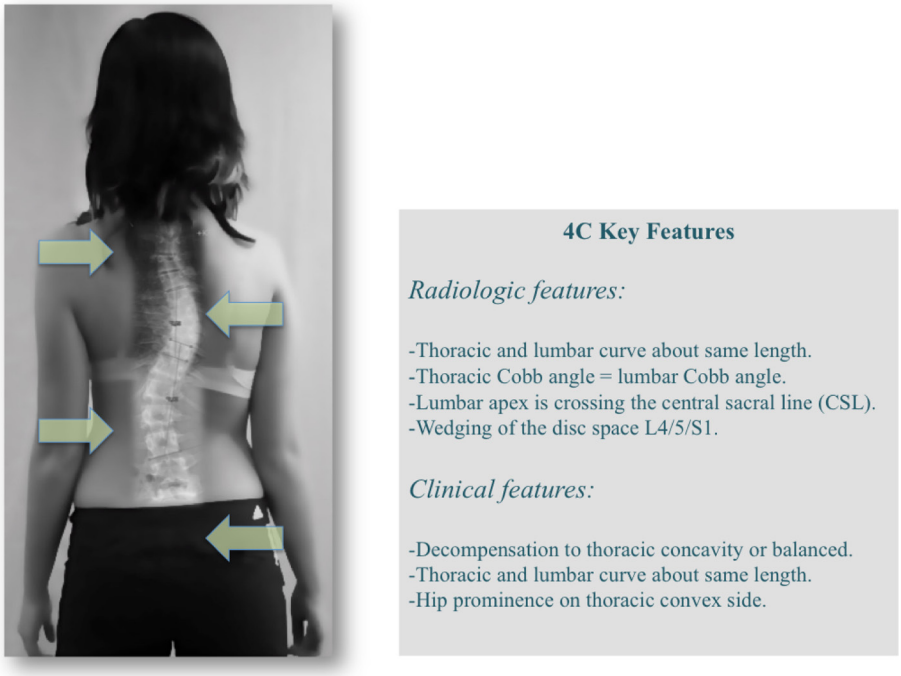

Fig. 3. Key features of the functional 4C pattern according to Schroth (courtesy of the Schroth Best Practice academy with kind permission).

An ethics approval and consent to participate was not applicable. No animals were used for studies of this research. Written informed consent for participation in this study has been obtained from both the patients and their parents; Consent for publication: Written informed consent for publication of the patient's information (X-rays, photos, records, etc.) has been obtained from both the patients and their parents.

RESULTS

The intra-observer Kappa value was 0.90 (acceptance >0.60) for the evaluation of the reliability of the clinical pictures and 1.00 for the evaluation of the x-ray pictures. The inter-observer Kappa values fluctuated from 0.58 to 0.80 (average 0.65; acceptance >0.60) for the evaluation of the reliability of the clinical pictures and fluctuated from 0.58 to 0.80 (average 0.71) for the evaluation of the reliability of the x-ray pictures.

DISCUSSION

In this test the intrarater reliability of the LS-classification was excellent with respect to clinical pictures and x-rays. Interrater reliability at average was exceeding the level of acceptability. The classification has shown to have a fair to good reliability clinically and radiologically[29, 30]. This curve pattern specific classification is used to prescribe exercise treatment approaches for individual patients[3, 6, 19]. According to the results from this study the use of this classification can be recommended for specialist Schroth certified physiotherapists in the functional rehabilitation using the pattern specific Schroth method. This test demonstrated sufficient reliability with respect to the x-rays, but the tests of the clinical pictures alone also demonstrated fair levels of reliability, which indicates that it is an appropriate tool for physiotherapists when an x-ray is not available. Although it is always wise to gain an image of the x-ray to confirm both the diagnosis and the pattern.

Within the pattern specific Schroth program it is necessary to distinguish between certain patterns of curvature. Only with pattern specific corrective movements can one achieve the best possible correction and avoid an increase of any counter curves same time[3, 19, 20].

While the 3C pattern of correction includes shifting and de-rotation of the shoulder-, thoracic- and lumbo-pelvic block against each other (Fig. 4) within the 4C correction the lumbopelvic block is split up into a lumbar and a pelvic block which are shifted and de-rotated against each other separately (Fig. 5). These basic principles of correction have also been used for pattern specific bracing in its earlier stages[31] while today for bracing slightly more complex classifications are used[3, 27–29].

Physiotherapists currently have no specialist standardised training in their generalised undergraduate or diploma courses worldwide regarding the treatment of scoliosis which may have led to the lack of involvement of therapists in treatment, unless for adults reporting pain or post-operative recovery. For a condition that is musculoskeletal and orthopaedic at least in its presentation this profession is not widely or specially educated in the mainstream. Orthotists training also varies worldwide and the profession can be poorly regulated in comparison to other health professions and orthotics for scoliosis are rarely standardised or even specified when prescribing.

If the standard of conservative physiotherapy treatment is Schroth, then a reliable reference classification tool is required which is also reliable between professionals, which the LS classification has demonstrated. As already outlined, there is a growing body of evidence for Schroth physiotherapy treatment, as this classification is not only simple but also reliable and standardized, and therefore should be integrated into physiotherapy educational programs. It is only through the successful identification of the specific pattern, can a professional then identify the effective pattern-specific exercises and postures to prescribe.

Limitation of this study is the small number of participants. For future studies within this topic a larger number of participants should be investigated. Another limitation is that some patients have been included who were already under brace treatment (n=15), an intervention, which might have led to a change of the trunk deformity. This might be the reason why the clinical application of the classification was less reliable than the radiologic application. Besides the dorsal aspect of the trunk the additional information in forward bending would also possibly improve the reliability, as the structural deformity is more visible in the forward bending test. This is the first time that a clinical and radiological reliability test for a scoliosis classification has been made. However, we actually have no data about the reliability comparing the clinical vs. radiological classification. This aspect should be investigated in future studies on this topic as well.

In conclusion: For the application of the exercises from the Schroth program the LS-classification seems an easy to use and reliable tool and should be considered important in the education of professionals prescribing exercises for patient with scoliosis.

Conflict of interest

HRW is receiving financial support for attending symposia and has received royalties from Koob GmbH & Co KG. The company is held by the spouse of HRW. HRW has held a patent on a sagittal realignment brace (EP 1 604 624 A1). DT is employed by an orthotist company providing specialist physiotherapy for spinal and chest /pectus deformities. None of the other authors report any competing interest or potential conflict of interest.

Fig. 4. Patient with a functional 3C pattern (left) corrected with thoracic shift and pelvic tilt to the thoracic convex side (with kind permission by Lambert Academic Publishing[3]).

Fig. 5. Patient with a functional 4C pattern (left) corrected with thoracic shift and pelvic tilt to the thoracic concave side (with kind permission by Lambert Academic Publishing[3]).

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HRW provided the first draft and made the literature review and served as the study supervisor. DT contributed to the improvement of the first draft, copyedited the final paper and provided the individual analysis of the data. XFN has provided the clinical pictures of the patients as well as their x-rays. AK (PhD in Mathematics) was in charge of statistical testing. MB supervised the ratings. XFN, MB and DT where performing the ratings with MB providing the intratester ratings.

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