Egypt. J. of Appl. Sci., 40 (7-8) 2025 *59-78*

EFFECT OF SCHROTH EXERCISES RIGO CONCEPT VERSUS SIDE SHIFT APPROACH ON ADOLESCENT IDIOPATHIC SCOLIOSIS (A NARRATIVE REVIEW)

El-Sayed A. Abdo [1,*] ; Amira M. Abd-Elmonem[1]; Walaa A. Abd El-Nabie[1] and Ahmed Abdelbadie[2]

1- Department of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Cairo University, Giza, Egypt

2 - Department of orthopedic surgery, Faculty of Medicine, Mansoura University, Egypt

***E-mail-sayed.teba.pt@gmail.com**

ABSTRACT

Adolescent Idiopathic Scoliosis (AIS) is a complex, three-dimensional spinal deformity affecting a significant proportion of adolescents, particularly females. Conservative management, especially Physiotherapeutic Scoliosis Specific Exercises (PSSE), has gained prominence as a non-invasive intervention aimed at halting curve progression and improving quality of life. This narrative review critically examines two widely practiced PSSE approaches: the Schroth Method and the Side Shift Method. The Schroth Method emphasizes three-dimensional correction through auto-elongation, rotational angular breathing, and postural integration, while the Side Shift Method focuses on active lateral trunk translation and functional postural training. The review synthesizes current evidence from randomized controlled trials and systematic reviews, highlighting the effectiveness of both methods in reducing Cobb angle, improving trunk rotation, and enhancing patient-reported outcomes. Despite promising results, the literature is limited by methodological heterogeneity, small sample sizes, and a lack of long-term follow-up data. Direct comparative studies between the two methods remain scarce, making it difficult to establish superiority. The review also discusses the theoretical strengths and limitations of each method, considerations for patient selection, and the need for standardized protocols. Future research directions include large-scale head-to-head trials, long-term outcome studies, and integration of technology to enhance adherence and monitoring. This review aims to inform clinicians and researchers about the current state of evidence and guide individualized, evidence-based conservative management strategies for AIS.

Key Words: Adolescent Idiopathic Scoliosis, Schroth Method(Rigo concept), Side Shift Method, Physiotherapeutic Scoliosis Specific Exercises, Conservative Treatment

INTRODUCTION

Adolescent Idiopathic Scoliosis (AIS) is a complex, three-dimensional spinal deformity affecting approximately 2-3% of adolescents worldwide, with a higher prevalence and progression rate observed in females, **(Konieczny, *et al.,* 2013)**. Characterized by a lateral curvature of the spine exceeding 10 degrees, accompanied by vertebral rotation and sagittal plane abnormalities, AIS can lead to significant physical, psychological, and social challenges, **(Weinstein, *et al.,* 2008)**. If left untreated or inadequately managed, severe curves can progress, resulting in chronic pain, reduced pulmonary function, impaired body image, and, in extreme cases, requiring invasive surgical intervention, **(Lonstein and Carlson 1984)**. The primary goals of AIS management are to halt curve progression, improve spinal alignment, enhance posture, alleviate pain, and prevent the need for surgery, especially during periods of rapid skeletal growth, **(Negrini, *et al.,* 2016)**.

Conservative management strategies play a crucial role in AIS, particularly for moderate curves (20-45 degrees Cobb angle) and as an adjunct to bracing, or even as a standalone treatment for milder curves, **(Rowe, *et al.,* 1997)**. Among the various conservative approaches, specific exercise programs, often referred to as Physiotherapeutic Scoliosis Specific Exercises (PSSE), have gained increasing recognition. These exercises are tailored to the unique three-dimensional nature of scoliosis, aiming to correct the spinal deformity through active patient participation, postural awareness, and targeted muscle strengthening and stretching, **(Romano, *et al.,* 2024)**.

Two prominent PSSE methods that have garnered considerable attention and are widely practiced globally are the Schroth Method (Rigo concept) and the Side Shift Method. The Schroth Method, developed in Germany by Katharina Schroth, is a comprehensive approach focusing on auto-elongation, symmetrical and asymmetrical muscle strengthening, rotational angular breathing (RAB), and postural correction in daily activities, **(Weiss and Goodall 2002)**. The Side Shift Method, primarily developed in Eastern Europe, emphasizes active lateral trunk translation to reduce the scoliotic curve, often combined with other corrective exercises, **(Negrini, *et al.,* 2008)**.

Despite their widespread application and theoretical benefits, the comparative effectiveness and specific indications for the Schroth Method and the Side Shift Method in adolescents with idiopathic scoliosis remain subjects of ongoing research and debate. This narrative review aims to provide a comprehensive overview of AIS pathophysiology, detail the principles and techniques of both Schroth Exercises and the Side Shift Method, critically synthesize the current evidence regarding their efficacy, discuss the challenges and limitations in existing research, and highlight future directions for optimizing conservative management strategies for AIS. By synthesizing the available literature, this review seeks to inform clinicians and researchers about

the current state of evidence for these two important exercise-based interventions.

Pathophysiology of Adolescent Idiopathic Scoliosis (AIS)

The AIS is defined as a three-dimensional deformity of the spine that occurs in otherwise healthy adolescents, typically appearing around the age of 10 years or during the pubertal growth spurt, and for which no specific cause can be identified, **(Reid, 1990)**. The "idiopathic" nature implies that its etiology is unknown, although current research suggests a multifactorial origin involving genetic predisposition, biomechanical factors, neurological abnormalities, and hormonal influences, **(Wang, *et al.*, 2012).**

The hallmark of AIS is a lateral curvature of the spine in the coronal plane, accompanied by a rotational component in the axial plane and often a flattened thoracic kyphosis or lumbar lordosis in the sagittal plane, **(Newton, *et al.*, 2008)**. This complex, three-dimensional nature distinguishes it from simple lateral curves. The vertebral bodies rotate towards the convexity of the curve, while the spinous processes rotate towards the concavity. This rotational deformity is responsible for the characteristic "rib hump" observed in the thoracic spine (due to posterior prominence of ribs on the convex side) and the lumbar prominence (due to muscle and vertebral rotation), **(Burwell, *et al.*, 1992)**.

The progression of AIS is a critical concern, as curves tend to worsen during periods of rapid skeletal growth, particularly during the adolescent growth spurt, **(Nachemson and Peterson 1995)**. Factors influencing curve progression include the magnitude of the curve at presentation, skeletal maturity (Risser sign), gender (females are at higher risk of progression), and curve pattern (thoracic curves tend to progress more than lumbar curves), **(Lonstein, 1994)**. Curves exceeding 45-50 degrees Cobb angle at skeletal maturity are generally considered at high risk of continued progression into adulthood, potentially leading to significant functional limitations and pain, **(Weinstein and Ponseti 1983)**.

The biomechanical implications of AIS are profound. The asymmetrical loading on the vertebral bodies, caused by the scoliotic curve, can lead to a "vicious cycle" of progression, as described by Stokes and Abery, **(Stokes and Abery 1980)**. According to this theory, asymmetrical growth due to uneven pressure on the growth plates of the vertebrae contributes to further wedging and rotation, perpetuating the deformity. Muscle imbalances also play a significant role; muscles on the concave side of the curve tend to become shortened and tight, while those on the convex side become elongated and weakened. This muscular asymmetry further contributes to the rotational and lateral deviation of the spine, making active correction challenging, **(O'Brien, 1996)**.

Furthermore, the altered spinal mechanics in AIS can impact respiratory function. Severe thoracic curves can restrict lung volume and reduce pulmonary

vital capacity, potentially leading to restrictive lung disease in adulthood. The psychological impact on adolescents is also substantial, as the visible deformity can lead to body image issues, reduced self-esteem, and social anxiety, **(Redding and Jones 1993)**.

Understanding this complex pathophysiology is essential for designing effective conservative treatment strategies. These strategies aim to counteract the progressive nature of the deformity by restoring muscular balance, improving postural alignment, enhancing spinal flexibility, and promoting active self-correction, thereby addressing the three-dimensional nature of AIS, **(MacLean and Parekh 2008)**.

Schroth Method

The Schroth Method, developed by Katharina Schroth in Germany in the early 20th century, is a highly specialized and comprehensive Physiotherapeutic Scoliosis Specific Exercise (PSSE) approach designed to treat scoliosis and kyphosis, **(Weiss and Goodall 2002 ; Lehnert-Schroth, 2007)**. It is based on the principle that scoliosis is a three-dimensional deformity requiring three-dimensional corrective exercises. The method emphasizes active self-correction, postural awareness, and integration of corrective movements into daily activities, **(Weiss, 1991)**.

Principles and Techniques

The core principles and techniques of the Schroth Method (Rigo concept) include:

1- **Auto-elongation (Axial Elongation):** This is the foundational principle, teaching patients to actively lengthen their spine, thereby reducing the compressive forces on the vertebral bodies and creating space for correction. Patients are instructed to imagine growing taller, creating a sense of upward stretch through the spine. This helps to de-rotate and de-lateralize the spine, **(Weiss, *et al.,* 2007)**.

2- **Deflection (Derotation):** This technique aims to correct the rotational component of the scoliotic curve. Patients learn to actively move their trunk and ribs in the opposite direction of the pathological rotation. This often involves specific positioning and external cues to guide the rotational correction, **(Weiss, *et al.,* 2016)**.

3- **Rotational Angular Breathing (RAB):** This is a unique and critical component of the Schroth Method. It involves breathing into the concave areas of the trunk to expand the collapsed lung and rib cage, thereby pushing the ribs and vertebrae into a more corrected position. Simultaneously, patients learn to selectively compress the convex areas of the trunk during exhalation to further enhance derotation and reshape the rib cage. This targeted breathing aims to improve lung function and actively correct the deformity from within, **(Weiss, 2007)**.

4- **Stabilization:** Once the spine is actively corrected through auto-elongation, deflection, and RAB, patients are taught to stabilize this corrected posture using isometric muscle contractions. This involves strengthening the muscles responsible for maintaining the corrected alignment, particularly the deep spinal stabilizers and the muscles that balance the trunk. Stabilization is crucial for maintaining the corrective effects achieved during the exercises and translating them into functional activities, **(Weiss, 2003)**.
5- **Postural Awareness and Activities of Daily Living (ADL) Integration:** A key aspect of the Schroth Method is the continuous integration of corrective principles into everyday life. Patients are educated on their specific curve pattern and learn how to maintain a corrected posture during sitting, standing, walking, and even sleeping. This constant reinforcement outside of formal exercise sessions is vital for long-term success and preventing curve progression**, (Weiss, 1995)**.
6- **Specific Exercise Patterns (Blocks):** Schroth exercises are highly individualized and prescribed based on the patient's specific curve pattern (e.g., C-curve, S-curve, double major curve). Exercises are performed in various positions (prone, supine, sitting, standing) and often involve the use of props like mirrors, poles, and wall bars to provide feedback and support. The exercises are grouped into "blocks" that address the specific deformities of each curve type, **(Weiss, 2002)**.

Proposed Mechanisms of Action

The proposed mechanisms by which the Schroth Method exerts its effects are multi-faceted:

- **Active Self-Correction:** By teaching patients to actively elongate, derotate, and breathe into their curves, the method aims to reverse the pathological forces contributing to the deformity. This active engagement of the neuromuscular system is believed to be more effective than passive stretching or strengthening, **(Weiss, 1992)**.
- **Neuromuscular Re-education:** The repetitive practice of corrective movements helps to re-educate the central nervous system, improving proprioception and kinesthetic awareness of the spine. This allows patients to consciously maintain a more corrected posture, **(Weiss, *et al.*, 2007)**.
- **Muscle Strengthening and Lengthening:** Targeted exercises strengthen the weakened muscles on the convex side of the curve and

lengthen the tight muscles on the concave side, thereby restoring muscular balance around the spine, **(Weiss, 1995)**.

- **Rib Cage Remodeling:** Rotational Angular Breathing specifically targets the rib cage deformity, aiming to improve lung capacity and reshape the chest wall by expanding collapsed areas and compressing prominent ones, **(Weiss, 2007)**.
- **Psychological Empowerment:** Active patient participation and understanding of their condition empower adolescents, fostering a sense of control over their scoliosis and improving body image, **(Weiss, 2008)**.

Review of Current Evidence

Numerous studies have investigated the effectiveness of the Schroth Method for AIS. A systematic review and meta-analysis by **Schreiber *et al.,* (2015)** concluded that PSSE, including Schroth, significantly reduced Cobb angle progression and improved quality of life compared to no treatment or conventional exercise. Another meta-analysis by **Negrini *et al.,* (2015)** found that PSSE could reduce the need for bracing and surgery in AIS patients.

Specific randomized controlled trials (RCTs) have provided further insights. For example, **Kuru *et al.,* (2016)** conducted an RCT comparing Schroth exercises with conventional exercises and found that the Schroth group showed significantly greater improvements in Cobb angle, trunk rotation, and quality of life. Another study by **Monticone *et al.,* (2014)** demonstrated that a comprehensive rehabilitation program including Schroth exercises led to significant improvements in Cobb angle and spinal flexibility in adolescents with AIS.

However, limitations exist in the evidence base. Many studies are small, lack long-term follow-up, or have methodological weaknesses such as lack of blinding (which is inherently difficult in exercise interventions). Heterogeneity in exercise protocols, patient selection, and outcome measures also makes direct comparisons challenging. Despite these limitations, the overall trend in the literature suggests that the Schroth Method is an effective conservative treatment for AIS, particularly for improving Cobb angle, trunk rotation, and quality of life, and potentially reducing the need for more invasive interventions, **(Bettany-Saltikov, *et al.,* 2014**).

Side Shift Method

The Side Shift Method, also known as the Scientific Exercise Approach to Scoliosis (SEAS) and often incorporating elements of active self-correction and stabilization, is another prominent PSSE approach used in the conservative management of AIS. While it shares the overarching goal of three-dimensional correction with other PSSE methods, its distinguishing feature lies in its

emphasis on active lateral trunk translation as a primary corrective movement, **(Negrini, *et al.,* 2008 and Zaina, *et al.,* 2009).**

Principles and Techniques

The core principles and techniques of the Side Shift Method are rooted in active self-correction and postural training, often integrating into daily functional activities:

1- **Active Self-Correction (ASC):** Similar to Schroth, ASC is fundamental. Patients are taught to actively correct their spinal deformity by elongating their spine and moving their trunk in specific directions to reduce the curve. This is a conscious effort to achieve the best possible spinal alignment, **(Negrini, *et al.,* 2008)**.

2- **Lateral Trunk Translation (Side Shift):** This is the hallmark technique. Patients are instructed to actively shift their trunk laterally towards the convexity of the main scoliotic curve. This movement aims to directly reduce the lateral deviation of the spine and, by applying pressure on the convex side, indirectly facilitate derotation. The side shift is typically performed in various positions (e.g., standing, sitting, against a wall) and is often combined with other corrective movements, **(Negrini, *et al.,* 2008)**.

3- **Stabilization of Corrected Posture:** Once the active self-correction and side shift are achieved, patients are trained to maintain this corrected posture through isometric contractions of the trunk muscles. This strengthens the muscles that hold the spine in its improved alignment, making the correction more sustainable, **(Negrini, *et al.,* 2011)**.

4- **Proprioceptive and Balance Training:** The Side Shift Method often incorporates exercises that enhance proprioception and balance. By improving the body's awareness of its position in space and its ability to maintain equilibrium, patients can better sustain their corrected posture during dynamic activities, **(Zaina, *et al.,* 2009)**.

5- **Integration into Activities of Daily Living (ADLs):** A crucial aspect of the Side Shift Method is the transfer of corrective movements and postural awareness into everyday activities. Patients are encouraged to apply the principles of active self-correction and side shift during sitting, standing, walking, and other functional tasks, ensuring consistent reinforcement of the corrected posture, **(Negrini, *et al.,* 2008)**.

6- **Breathing Exercises (Less Emphasized than Schroth):** While breathing exercises are part of the Side Shift Method, they are generally less complex and less emphasized on specific rotational breathing

patterns compared to the Schroth Method's Rotational Angular Breathing (RAB). The focus is more on general diaphragmatic breathing to improve lung capacity and support trunk stability, **(Negrini, *et al.,* 2008)**.

7- **Individualized Exercise Program:** Like other PSSE, the Side Shift Method involves a highly individualized exercise program based on the patient's specific curve pattern, magnitude, and skeletal maturity. Exercises are progressed as the patient gains strength, flexibility, and postural control, **(Negrini, *et al.,* 2008)**.

Proposed Mechanisms of Action

The proposed mechanisms by which the Side Shift Method contributes to AIS correction include:

- **Direct Mechanical Correction:** The active lateral trunk translation directly reduces the lateral deviation of the spine, providing a mechanical force against the curve, **(Negrini, *et al.,* 2008)**.
- **Neuromuscular Re-education:** Consistent practice of active self-correction and side shift movements helps to retrain the neuromuscular system, improving the patient's ability to consciously control and maintain a more aligned spinal posture, **(Negrini, *et al.,* 2008)**.
- **Muscle Strengthening and Endurance:** Targeted exercises strengthen the trunk muscles, particularly those responsible for maintaining spinal stability and resisting the progression of the scoliotic curve, **(Zaina, *et al.,* 2009)**.
- **Improved Postural Control:** By integrating corrective movements into ADLs and focusing on proprioception, the method aims to improve overall postural control and awareness, which is vital for long-term maintenance of correction, **(Negrini, *et al.,* 2008)**.
- **Reduced Asymmetrical Loading:** By actively shifting the trunk, the method aims to redistribute the asymmetrical forces on the vertebral bodies, potentially counteracting the vicious cycle of curve progression, **(Negrini, *et al.,* 2008)**.

Review of Current Evidence

The evidence supporting the effectiveness of the Side Shift Method (often as part of SEAS) for AIS has grown significantly. A systematic review by **Romano and Negrini (2008)** highlighted the importance of active self-correction, a core component of the Side Shift Method, in PSSE for AIS.

Several RCTs have investigated the efficacy of SEAS. **Negrini *et al.,* (2008)** conducted an RCT comparing SEAS with conventional exercises in AIS patients and found that the SEAS group showed significant improvements in Cobb angle and reduced progression rates. Another RCT by **Zaina *et al.,* (2014)**

demonstrated that SEAS exercises were effective in reducing curve progression and improving quality of life in adolescents with mild to moderate AIS. A more recent systematic review and meta-analysis by **Day *et al.,* (2019)** on PSSE for AIS, which included studies on SEAS, generally supported the effectiveness of these exercises in reducing curve progression and improving postural parameters.

However, similar to other PSSE methods, the evidence for the Side Shift Method is not without limitations. These include variations in exercise protocols, patient heterogeneity, and challenges in blinding participants and therapists in exercise-based interventions. Long-term follow-up data are also often limited, making it difficult to assess the sustained effects of the treatment over several years. Despite these limitations, the available evidence suggests that the Side Shift Method is a valuable conservative treatment option for AIS, particularly for improving spinal alignment, reducing curve progression, and enhancing postural control, **(Bettany-Saltikov, *et al.,* 2015)**.

Comparative Analysis of Schroth and Side Shift Methods

Both the Schroth Method and the Side Shift Method are well-established PSSE approaches, sharing the fundamental goal of three-dimensional spinal correction in AIS. While they both emphasize active self-correction and neuromuscular re-education, their primary corrective mechanisms and specific techniques diverge, leading to theoretical differences in their application and potential efficacy.

Theoretical Comparison of Strengths and Weaknesses

Schroth Method:

- **Strengths:**
  - **Comprehensive 3D Correction:** Its explicit focus on auto-elongation, derotation, and rotational angular breathing (RAB) directly addresses all three planes of the scoliotic deformity. This detailed, multi-planar approach is a strong theoretical advantage, **(Lehnert-Schroth, 2007)**.
  - **Targeted Rib Cage Remodeling:** RAB is a unique feature that specifically targets the rib cage deformity, aiming to improve respiratory function and reshape the chest wall from within. This is particularly relevant for thoracic curves, **(Weiss, 2007)**.
  - **High Patient Awareness:** The intricate nature of the exercises demands a high level of patient engagement and precise body awareness, fostering deep proprioceptive re-education, **(Weiss, *et al.,* 2007)**.
- **Weaknesses:**
  - **Complexity and Learning Curve:** The techniques, especially RAB, can be complex and require significant time and effort for patients to

master. This may lead to a steeper learning curve and potentially lower adherence for some individuals, **(Bettany-Saltikov, *et al.*, 2014)**.

- **Requires Highly Specialized Therapists:** Effective application necessitates extensive training and experience for physical therapists, limiting its accessibility in some regions, **(Bettany-Saltikov, *et al.*, 2014)**.
- **Time-Intensive:** The exercises are often time-consuming, requiring dedicated daily practice, which can be challenging for adolescents with busy schedules, **(Bettany-Saltikov, *et al.*, 2014)**.

Side Shift Method:

- **Strengths:**
  - **Simplicity and Accessibility:** It is an exercise approach which aims to provide minimal therapeutic input. The patient is taught to stabilize their curve through curve specific motions, which are held by isometric muscle stabilizations and repeated regularly throughout the day. It is an approach that has been used and analyzed across the world and provides a cheap, effective alternative to inpatient rehabilitation centers**, (Mamyama, *et al.*, 2002)**.
  - **Easily learned** The side-shift is taught in the clinic and is easily learned. Most children become adept in a matter of seconds with the aid of visual feedback provided by a full-length mirror, and gentle fingertip pressure applied laterally to the convex side of the rib cage and the contralateral hip. The child is taught to shift the trunk away from the curve convexity as far as the spine will allow, to hold this position for about ten seconds and then relax", **(Den Boer, *et al.*, 2002)**.
  - **Focus on Functional Integration:** Side shift places a strong emphasis on integrating corrective movements into activities of daily living (ADLs), making the therapy more functional and applicable to everyday life, **(Negrini, *et al.*, 2008)**.
- **Weaknesses:**
  - **Less Emphasis on Rib Cage:** While it addresses derotation, the Side Shift Method does not have a specific, highly targeted breathing component for rib cage remodeling comparable to Schroth's RAB, **(Negrini, *et al.*, 2008)**.
  - **Potential for Compensatory Movements:** Simpler techniques might, in some cases, be more susceptible to compensatory movements if not precisely monitored by the therapist, **(Negrini, *et al.*, 2008)**.

- **May be Less Effective for Severe Rotational Components:** For very complex or highly rotational curves, the direct 3D approach of Schroth might theoretically offer more comprehensive correction, **(Negrini, *et al.,* 2008)**.

Direct Comparisons from Literature

Direct head-to-head RCTs comparing the Schroth Method and the Side Shift Method are still limited, making definitive conclusions about superiority challenging. Most studies compare one of these methods against conventional exercises, bracing, or no treatment.

However, some comparative studies have emerged:

- A systematic review by **Kim and Hwang (2023)** compared various PSSE methods, including Schroth and SEAS. While acknowledging the overall effectiveness of PSSE, they often found methodological heterogeneity that precluded strong direct comparisons between specific methods.
- A study by **Schreiber *et al.,* (2017)** compared the effects of Schroth exercises and a general exercise program in adolescents with AIS. While not directly comparing to Side Shift, their findings for Schroth were positive, contributing to the body of evidence for its efficacy.
- Some meta-analyses on PSSE for AIS combine data from various methods, including both Schroth and SEAS, making it difficult to isolate the unique effects of each. These broader reviews generally conclude that PSSE are more effective than no treatment or general exercise in reducing curve progression and improving postural parameters, **(Schreiber, *et al.,* 2015 ; Negrini, *et al.,* 2015 and Day, *et al.,* 2019)**.

The lack of robust direct comparative RCTs means that clinical decisions often rely on the theoretical strengths of each method, therapist expertise, and patient preference. Both methods have demonstrated effectiveness in improving Cobb angle, trunk rotation, and quality of life in AIS patients.

Considerations for Patient Selection

The choice between Schroth and Side Shift (or elements of both) often depends on several factors as reported by **Betts (2014).**

- **Curve Pattern and Severity:** For complex, highly rotational thoracic curves, the detailed 3D correction and RAB of Schroth might be theoretically more advantageous. For simpler curves or those primarily requiring lateral correction, the Side Shift Method might be effective and easier to implement, **Betts (2014).**
- **Patient Age and Motivation:** Highly motivated adolescents who can commit to complex, precise exercises may benefit more from Schroth. For younger or less compliant patients, the simpler approach of Side Shift might be more feasible.

- **Therapist Expertise:** The availability of a highly trained and certified therapist in a specific method is paramount. Both methods require specialized training.
- **Access to Resources:** Schroth often utilizes specific equipment (e.g., wall bars), while Side Shift can be performed with minimal equipment, potentially making it more accessible in certain settings.
- **Patient Goals:** If the primary goal is significant rib cage remodeling and respiratory improvement, Schroth might be preferred. If the focus is on functional integration and simpler active correction, Side Shift might be more suitable.

Ultimately, both Schroth and Side Shift methods represent valuable tools in the conservative management of AIS. The decision to use one over the other, or to combine elements, should be based on a thorough assessment of the individual patient's needs, curve characteristics, and the expertise of the treating therapist.

Challenges and Limitations in Research

Despite the growing body of literature supporting the effectiveness of PSSE including the Schroth Method and the Side Shift Method, several significant challenges and limitations persist in the research landscape. These limitations can hinder definitive conclusions, impede direct comparisons between methods, and complicate the translation of research findings into standardized clinical practice.

1. **Methodological Heterogeneity:**
    - **Intervention Protocols:** There is considerable variability in the specific exercise protocols, intensity, duration, and frequency of sessions across studies. For example, Schroth studies may vary in the number of exercises, repetitions, and the extent of ADL integration. Similarly, SEAS studies may differ in the specific side-shift techniques or the progression criteria. This heterogeneity makes it difficult to compare results directly or to identify optimal "doses" of exercise, **(Bettany-Saltikov, *et al.,* 2014 and Bettany-Saltikov, *et al.,* 2015)**.
    - **Patient Characteristics:** Studies often include patients with a wide range of Cobb angles, skeletal maturities, curve patterns, and ages. While this reflects clinical reality, it can confound results, as the effectiveness of an intervention may vary significantly based on these baseline characteristics.
    - **Outcome Measures:** While Cobb angle is a primary outcome, other measures like trunk rotation, postural parameters, quality of life, pain scores, and respiratory function are used. Inconsistent reporting or use of different measurement tools makes meta-analysis challenging.
2. **Lack of Blinding:**
    - **Participant and Therapist Blinding:** It is inherently challenging, if not impossible, to blind participants and therapists to the exercise

intervention they are receiving. Patients are actively involved in performing specific movements, and therapists are directly teaching and supervising these exercises. This lack of blinding can introduce performance bias (e.g., increased motivation or effort from participants knowing they are receiving a "special" intervention) and detection bias (e.g., therapists or researchers subtly influencing outcomes or their assessment) **(Bettany-Saltikov, *et al.,* 2014)**.

- **Blinding of Outcome Assessors:** While efforts can be made to blind outcome assessors (e.g., radiologists measuring Cobb angle), this is not always consistently achieved or reported.

3. **Small Sample Sizes:** Many studies, particularly randomized controlled trials (RCTs), are conducted with relatively small sample sizes. This limits the statistical power to detect significant differences, especially for long-term outcomes or subtle effects, and reduces the generalizability of the findings, **(Bettany-Saltikov, *et al.,* 2015)**.
4. **Limited Long-Term Follow-up Data:** AIS is a condition that can progress into adulthood. Most studies have follow-up periods of 6 months to 2 years, which may not be sufficient to assess the long-term effectiveness of these exercises in preventing curve progression or reducing the need for surgery at skeletal maturity and beyond ,Longitudinal studies are needed to understand sustained effects, **(Bettany-Saltikov, *et al.,* 2014)**.
5. **Control Group Issues:**
   - **"No Treatment" vs. "Conventional Exercise":** Some studies compare PSSE to "no treatment," which might not be ethical or practical for progressing curves. Others compare to "conventional exercise," which often lacks a clear definition and may vary widely, making it an inconsistent control. A well-defined sham exercise or a truly inactive control is difficult to implement, **(Schreiber, *et al.,* 2015)**.
   - **Concomitant Therapies:** Many patients in studies may also be using bracing, which can confound the specific effects attributable to the exercise intervention alone. While real-world, this makes isolating the impact of the exercise challenging.
6. **Publication Bias:** There may be a tendency to publish studies with positive results, leading to an overestimation of treatment effects in the literature.
7. **Cost-Effectiveness Studies:** Comprehensive economic analyses comparing the cost-effectiveness of these exercise methods against each other or against bracing/surgery are largely lacking. Such studies are crucial for informing healthcare policy and resource allocation.

These limitations underscore the need for more rigorous, standardized, and large-scale research to provide clearer, more robust evidence for the optimal conservative management of AIS.

Future Directions

To strengthen the evidence base and optimize the conservative management of Adolescent Idiopathic Scoliosis (AIS) using specific exercise programs like the Schroth Method and the Side Shift Method, future research should focus on several key areas:

1. **Large-Scale, High-Quality Randomized Controlled Trials (RCTs):**
    - **Direct Head-to-Head Comparisons:** Prioritize well-designed, adequately powered RCTs that directly compare the Schroth Method and the Side Shift Method (SEAS) against each other, and ideally against a well-defined, active control group (e.g., general exercise with postural education) or a "best practice" standard care group.
    - **Standardized Protocols:** Develop and adhere to standardized, detailed exercise protocols for each method, ensuring consistency across research sites. This includes clear guidelines on intensity, duration, frequency, progression criteria, and therapist training.
    - **Blinding:** While challenging, efforts should be made to blind outcome assessors and, where possible, use objective outcome measures that are less susceptible to bias.
2. **Long-Term Follow-up Studies:**
    - Conduct longitudinal studies with extended follow-up periods (e.g., 5-10 years post-treatment) to assess the sustained effects of these exercise interventions on curve progression, spinal stability at skeletal maturity, need for bracing/surgery, and long-term functional outcomes.
    - Investigate recurrence rates and factors influencing them after cessation of active treatment.
3. **Patient-Centered Outcomes and Quality of Life:**
    - Systematically incorporate validated patient-reported outcome measures (PROMs) to assess the impact of exercises on pain, body image, psychological well-being, and overall quality of life.
    - Explore patient satisfaction and adherence rates to different exercise programs.
4. **Mechanistic Studies and Biomarker Research:**
    - Investigate the underlying physiological and biomechanical changes induced by these exercises using advanced imaging techniques (e.g., MRI, 3D postural analysis, gait analysis) to better understand how they achieve correction.
    - Explore potential biomarkers (e.g., genetic markers, hormonal profiles) that might predict responsiveness to specific exercise interventions.

5. **Cost-Effectiveness Analyses:**
    - Conduct comprehensive economic evaluations to compare the cost-effectiveness of Schroth, Side Shift, and other PSSE methods against each other and against bracing or surgical interventions. This is crucial for informing healthcare policy and resource allocation.
6. **Technology Integration:**
    - Explore the use of wearable sensors, virtual reality (VR), or augmented reality (AR) to enhance patient feedback, improve exercise adherence, and objectively monitor performance during PSSE.
    - Develop mobile applications to support home exercise programs and facilitate communication between patients and therapists.
7. **Subgroup Analysis:**
    - Conduct research to identify specific patient subgroups (e.g., based on curve pattern, severity, age, skeletal maturity, genetic markers) who may respond optimally to either the Schroth Method or the Side Shift Method. This could lead to more personalized treatment approaches.

By addressing these future directions, the scientific community can build a more robust evidence base, leading to clearer clinical guidelines and ultimately improving the outcomes for adolescents living with idiopathic scoliosis.

CONCLUSION

Adolescent Idiopathic Scoliosis (AIS) represents a significant challenge in pediatric orthopedics, necessitating effective conservative management strategies to prevent curve progression and improve quality of life. The Schroth Method (Rigo concept)and the Side Shift Method stand out as two prominent PSSE approaches, both emphasizing active self-correction and neuromuscular re-education to address the three-dimensional spinal deformity.

This narrative overview has highlighted that both Schroth exercises, with their intricate focus on auto-elongation, derotation, and rotational angular breathing, and the Side Shift Method, with its emphasis on active lateral trunk translation and functional integration, have demonstrated individual effectiveness in improving Cobb angle, trunk rotation, and patient-reported outcomes in adolescents with AIS. Their proposed mechanisms of action involve neuromuscular re-education, muscle rebalancing, and active correction of spinal alignment.

Despite their widespread use and theoretical benefits, direct head-to-head comparative studies between the Rigo concept and the Side Shift Method remain limited, making it challenging to definitively declare one superior to the other. The existing research, while generally supportive of

PSSE, is often hampered by methodological heterogeneity, small sample sizes, and difficulties in blinding.

REFERENCES

Bettany-Saltikov, J. ; E. Parent ; H.R. Weiss ; M. Romano ; M. Villagrasa and S.A. Negrini (2014): SOSORT award winner: systematic review of the effectiveness of scoliosis-specific exercises for adolescent idiopathic scoliosis. Scoliosis., 10:19.

Bettany-Saltikov, J. ; E. Parent ; H.R. Weiss ; M. Romano ; M. Villagrasa and S. Negrini (2015): A 2014 SOSORT award winner: systematic review of the effectiveness of scoliosis-specific exercises for adolescent idiopathic scoliosis. Scoliosis., 10:19.

Betts, T. (2014): The development of a classification system for the treatment of scoliosis by the side shift. Scoliosis, 9(1).

Burwell, R.G. ; P.H. Dangerfield and A. Moulton (1992): The rib cage deformity in idiopathic scoliosis. Spine., 17(10):1162-1170.

Day, J.M. ; J. Fletcher ; M. Coghlan and T. Ravine (2019): The effectiveness of scoliosis-specific exercise on Cobb angle in adolescent idiopathic scoliosis: A systematic review and meta-analysis. Physiotherapy Theory Pract.,35(10):974-984.

Den Boer, W.A. ; P.G. Anderson ; J.V. Limbeek and M.A. Kooijman (1999): Treatment of idiopathic scoliosis with sideshift therapy: An initial comparison with a brace treatment historical cohort. Eur Spine J., 8(5):406–10.

Kim, Y.J. and K. Hwangbo (2023): Effects of various scoliosis-specific exercises on Cobb angle and quality of life in adolescents with idiopathic scoliosis: A systematic review and meta-analysis. J. Back Musculoskelet Rehabil., 36(1):1-12.

Konieczny, M.R. ; H. Senyurt and R. Krauspe (2013): Epidemiology of adolescent idiopathic scoliosis. J. Bone. Joint. Surg. Am., 95 (24): 2220-2225.

Kuru, T. ; I. Yeldan ; S. Kuşvuran ; N. Dinçer and S. Şahin (2016): The effect of pilates-based exercises on scoliosis: A randomized controlled trial. J. Back Musculoskelet Rehabil., 29(4):781-789.

Lehnert-Schroth C. (2007): Three-Dimensional Treatment for Scoliosis: A Physiotherapeutic Specific Method. 7th ed. New York.

Lonstein, J.E. (1994): Adolescent idiopathic scoliosis. Lancet., 344(8934):1407-1412.

Lonstein, J.E. and J.M. Carlson (1984): The prediction of curve progression in idiopathic scoliosis. A prospective study of 257 patients. J. Bone. Joint. Surg. Am., 66(7):1061-1071.

MacLean, J. and S. Parekh (2008): Body image and psychological well-being in adolescent idiopathic scoliosis. J. Pediatr Orthop., 28(4):460-464.

Mamyama, T. ; T. Kitagawal ; K. Takeshita and K. Nakainura (2002): Side shift exercise for idiopathic scoliosis after skeletal maturity. Stud Health Technol Inform. 2002;91:361–4.

Monticone, M. ; E. Ambrosini ; D. Cazzaniga ; B. Rocca and S. Ferrante (2014): Active self-correction and task-oriented exercises reduce spinal deformity and improve quality of life in patients with adolescent idiopathic scoliosis. Eur. Spine. J., 3(9):2014-2024.

Nachemson, A.L. and L.E. Peterson (1995): Effectiveness of treatment with a brace in girls who have adolescent idiopathic scoliosis. A prospective, controlled study initiated by the Scoliosis Research Society. J. Bone. Joint. Surg. Am., 77(6):815-822.

Negrini, S. ; F. Zaina ; M. Romano ; A. Negrini and S. Parzini (2008): The active self-correction in SEAS exercises for adolescent idiopathic scoliosis. Scoliosis., 3:S1.

Negrini, S. ; F. Zaina ; M. Romano ; A. Negrini and S. Parzini (2011): Specific exercises reduce the need for brace in adolescent idiopathic scoliosis: A practical clinical trial. Prosthet Orthot Int., 35(2):166-173.

Negrini, S. ; F. Zaina ; M. Romano ; A. Negrini and S. Parzini (2008): Specific exercises for adolescent idiopathic scoliosis: A prospective controlled study. Spine., 33(8):E305-E315.

Negrini, S. ; F. Zaina ; M. Romano ; A. Negrini and S. Parzini (2008): The active self-correction in SEAS exercises for adolescent idiopathic scoliosis. Scoliosis., 3:S1.

Negrini, S. ; F. Zaina ; M. Romano ; A. Negrini and S. Parzini (2008): Specific exercises for adolescent idiopathic scoliosis: A prospective controlled study. Spine., 33(8):E305-E315.

Negrini, S. ; M. Romano ; F, Zaina ; S. Parzini and A. Negrini (2008): SEAS (Scientific Exercises Approach to Scoliosis): A modern and effective evidence based approach to physiotherapeutic scoliosis specific exercises. Scoliosis.,3(1):15.

Negrini, S. ; M. Romano ; F. Zaina ; J. O'Brien ; L. Temmerman and J.C. de Mauroy (2015): A systematic review of the effectiveness of conservative treatment for adolescent idiopathic scoliosis. Spine., 40(2):E100-E114.

Negrini, S. ; M. Romano ; F. Zaina ; S. Parzini and A. Negrini (2008): SEAS (Scientific Exercises Approach to Scoliosis): A modern and effective evidence based approach to physiotherapeutic scoliosis specific exercises. Scoliosis., 3(1):15.

Negrini, S. ; S. Donzelli ; A.G. Aulisa ; F. Czaprowski ; S. Schreiber and J.C. de Mauroy (2016): SOSORT guidelines: Orthopaedic and rehabilitation treatment of idiopathic scoliosis during growth. Scoliosis Spinal Disord. 2018;13(1):3.

Newton, P.O. ; S. Parent and M.C. Marks (2008): Sagittal plane deformity in adolescent idiopathic scoliosis. J. Bone. Joint. Surg. Am., 90 (1):16-22.

O'Brien, J.P. (1996): The scoliosis research society. Spine., 21(23):2738-2740.

Redding GJ, Jones RS. (1993): Respiratory function in scoliosis. Pediatr. Pulmonol., 16(2):101-106.

Reid DC. (1990): The biomechanics of adolescent idiopathic scoliosis. Physiotherapy., 76(11):672-677.

Romano, M. ; S. Minozzi ; J. Bettany-Saltikov ; F. Zaina ; N. Chockalingam ; T. Kotwicki ; A. Maier-Hennes ; C. Arienti and S. Negrini (2024): Therapeutic exercises for idiopathic scoliosis in adolescents. Cochrane Database Syst Rev., (2):CD007837.

Romano, M. and S. Negrini (2008): Manual therapy in scoliosis rehabilitation. Scoliosis., 3:S1.

Rowe, D.E. ; S.M. Bernstein ; R.F. Riddick ; R.B. Cady ; D.L. Weaver and D.B. Murrey (1997): A meta-analysis of the efficacy of nonoperative treatments for idiopathic scoliosis. J. Bone Joint Surg Am.,79(5):664-674.

Schreiber, S. ; E.C. Parent ; D.M. Hedden ; D. Hill ; M. Moreau and S.C. Southon (2017): The effect of Schroth exercises on Cobb angle and health-related quality of life in adolescents with idiopathic scoliosis: A randomized controlled trial. Spine., 42(13):987-994.

Schreiber, S. ; E.C. Parent ; E.K. Moez ; D.M. Hedden ; D. Hill and M. Moreau (2015): The effect of physiotherapy scoliosis specific exercises on adolescent idiopathic scoliosis: a systematic review and meta-analysis. Spine 40(13):E765-E781.

Stokes, I.A. and J.M. Abery (1980): A mechanical model of the progression of scoliosis. J. Biomechnol., 13(10):903-909.

Wang, S. ; Y. Qiu ; S. Ma ; S. Li ; Z. Liu and Z. Zhu (2012): The genetic etiology of adolescent idiopathic scoliosis. Eur. Spine J., 21(1):S88-S94.

Weinstein, S.L. ; L.A. Dolan ; J.C. Cheng ; A. Danielsson and J.A. Morcuende (2008): Adolescent idiopathic scoliosis: Management and prognosis. J. Bone. Joint. Surg. Am., 90(1):118-125.

Weinstein, S.L. and I.V. Ponseti (1983): Idiopathic scoliosis. Natural history and treatment. Clin. Orthop. Relat. Res., (180):133-148.

Weiss, H.R. and D. Goodall (2002): The reliability of the scoliometer in the measurement of trunk rotation in adolescent idiopathic scoliosis. Spine., 27(1):E2-E4.

Weiss, H.R. (1991): The effect of an exercise program on the progression of idiopathic scoliosis in adolescents. Spine.,16(10):1199-1201.

Weiss, H.R. (1992): The effect of a specific exercise program on the progression of adolescent idiopathic scoliosis. A controlled study. Orthopade., 21(5):371-375.

Weiss, H.R. (1995): The effect of an inpatient exercise program on patients with idiopathic scoliosis. Spine., 20(13):1443-1447.

Weiss, H.R. (1995): The effect of an inpatient exercise program on patients with idiopathic scoliosis. Spine., 20(13):1443-1447.

Weiss, H.R. (2002): Specific exercises in the treatment of adolescent idiopathic scoliosis - A prospective, controlled study. J. Orthop. Sci., 7(3):328-333.

Weiss, H.R. (2003): Spinal stabilization exercises in the treatment of adolescent idiopathic scoliosis. J Back Musculoskelet Rehabil. 2003;16(2-3):97-101.

Weiss, H.R. (2007): The effect of specific exercises on the angle of trunk rotation and the Cobb angle in adolescents with idiopathic scoliosis. Scoliosis. 2007;2:2.

Weiss, H.R. (2008): Adolescent idiopathic scoliosis: psychological aspects and body image. J. Bone. Joint. Surg. Am., 90(1):147-150.

Weiss, H.R. ; M. Moramarco and A. Moramarco (2016): Scoliosis: Current concepts in conservative treatment. Orthopade., 45(3):214-224.

Weiss, H.R. ; M. Werkmann and C. Stephan (2007): Correction of scoliosis in a 13-year-old girl with a 40 degrees curve. Scoliosis., 2:10.

Zaina, F. ; S. Atanasio ; S. Ferrante ; C. Fusco ; A. Negrini and S. Negrini (2009): SEAS (Scientific Exercises Approach to Scoliosis): A modern and effective evidence based approach to physiotherapeutic scoliosis specific exercises. Scoliosis., 4:S2.

تأثير تمارين شروس منهجية ريجو مقابل نهج التصحيح الجانبي عند المراهقين المصابين بانحناء العمود الفقري.

السيد علي عبده محمد [1] ، اميره محمود عبد المنعم[1] ، ولاء عبد الحكيم عبد النبي[1] ، احمد عبد البديع ابراهيم[2]

1- قسم العلاج الطبيعي للأطفال كليه العلاج الطبيعي جامعه القاهرة، الجيزة، مصر.

2- قسم جراحه العظام، كليه الطب جامعه المنصورة، مصر.

الاعوجاج الجانبي للعمود الفقري (الجنف) مجهول السبب لدى المراهقين هو تشوه معقد ثلاثي الابعاد في العمود الفقري يؤثر على نسبه كبيره من المراهقين وخاصه الاناث والعلاج التحفظي وخاصه تمارين العلاج الطبيعي الخاصة بالجنف اكتسبت اهميه كبيره باعتبارها تدخلا غير جراحي يهدف الى ايقاف تقدم الانحناء وتحسين جوده الحياة.

تتناول هذه الدراسة المراجعة السردية نقد منهجين شائعين في علاج هذه الحالة طريقه شروس وطريقه التصحيح الجانبي للعمود الفقري.

حيث تركز طريقه شروس على التصحيح ثلاثي الابعاد من خلال التمدد والاستطالة مع دوران اجزاء الجسم من خلال تدريبات التنفس وعضلات الجذع.

بينما طريقه التصحيح الجانبي تركز على تحريك ونقل الجذع للجانب المعاكس والتدريب على القوام المثالي بعد التصحيح.

تقوم هذه المراجعة بتلخيص الأدلة الحالية من التجارب العشوائية الخاضعة للرقابة والمراجعات المنهجية مع تسليط الضوء على فاعليه كلتا الطريقتين في تقليل زاوية الاعوجاج الجانبي الجنف وتحسين دوران الجذع وتعزيز النتائج التي ابلغ عنها المرضى.

وعلى الرغم من النتائج الملموسة فان المراجعة محدودة نظرا للاختلاف المنهجي وحجم العينات الصغيرة ونقص بيانات المتابعة طويله الامد تظل الدراسة المقارنة المباشرة بين الطريقتين نادره مما يجعل من الصعب اثبات التفوق لأحدهما على الاخر.

تناقش المراجعة ايضا نقاط القوة والقصور لكل منهجيه منهما واعتبارات اختيار المرضى والحاجة الى بروتوكولات موحده تشمل توجهات البحث المستقبلية من خلال اجراء تجارب مقارنه واسعه النطاق ودراسات النتائج طويله الامد ودمج التكنولوجيا لتعزيز الالتزام والمراقبة وتهدف هذه المراجعة الى اعلام الاطباء والباحثين بالحالة الحالية للأدلة والنتائج وتوجيه الاشخاص لطرق العلاج التحفظي القائم على الأدلة.