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ORIGINAL RESEARCH REGIONAL ANESTHESIA

Effect of the Schroth method on the magnitude of lumbar curves and endurance of lumbar extensors in children with idiopathic scoliosis

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ABSTRACT

Background & objective: Lumbar extensors' strength and endurance are crucial for maintaining spinal alignment and balance, especially in patients with idiopathic scoliosis. This study aims to investigate the effects of the Schroth method on the magnitude of lumbar curve and endurance of lumbar extensors in children with idiopathic scoliosis.

Methodology: This single-blinded randomized controlled trial (RCT_ included 32 patients. Data was collected from Pakistan Society for Rehabilitation of Differently Abled Lahore, by using a convenience sampling technique through the fishbowl method of randomization. Idiopathic scoliosis patients aged between 9 and 17 years with Cobb angles of 10˚– 26˚ of either gender were included. Patients with any neurological condition, other orthopedic condition, surgical history of spine, severe systemic disorder, psychiatric or neuromuscular disorder were excluded from the study—X-ray data collection for Cobb angle and Sorensen test for lumbar muscle endurance.

Results: On applying independent sample t test for between group analysis, it was seen that no difference was found at the baseline before the treatment between both the groups ($P > 0.05$), It was also seen that the improvement in experimental group was seen to be more than in control group with respect to curve magnitude (Cobb angle) and endurance (Sorensen test) ($P < 0.05$). On applying the within-group comparison paired sample t test, it was seen that both groups showed effectiveness after the treatment sessions ($P < 0.05$).

Conclusion: In conclusion, it was proved that the Schroth method is effective in improving curve magnitude and endurance of lumbar extensors in children with idiopathic scoliosis.

Keywords: Children; Cobb angle; Endurance; Exercise Therapy; Idiopathic; Lumbar; Schroth method; Scoliosis; Sorensen test

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1. INTRODUCTION

Scoliosis, originating from the ancient Greek word "skolios" meaning curved, is a spinal deformity characterized by a lateral curvature of the spine exceeding 10 degrees, as measured by the Cobb angle on radiographs.[1] This condition primarily emerges during the first two decades of life and is broadly classified into two main types: idiopathic and secondary scoliosis. Idiopathic scoliosis, which accounts for approximately 85% of all scoliosis cases, arises without a known cause and is further subdivided based on the age of onset into infantile, juvenile, and adolescent forms.[2] Secondary scoliosis results from underlying conditions such as neuromuscular disorders, tumors, or syndromic anomalies. From the age of 10 to 16, adolescent idiopathic scoliosis is very prevalent during puberty. Idiopathic scoliosis is present in around 4% to 2% out of which girls are more likely to have a severe spinal curve in comparison with boys.[3] Early detection and management of idiopathic scoliosis is very important due to its progression, which leads towards functional impairment such as sky forces, cardio pulmonary complications, as well as reduction in quality of life. The endurance and magnitude of the lumbar extensor muscles are commonly affected in idiopathic scoliosis. These muscles are responsible for maintaining the upright posture, along with spinal stability and facilitation in movement like lateral bending and extension. This group of muscles is the erector spinae group of muscles.[4] People with idiopathic scoliosis have abnormal curvature of the spine, which can result in asymmetrical loading and muscle imbalance. The convex side of the abnormal curve has muscles that are hypertonic and overactive due to increased strain. On the other hand, the concave side becomes hypotonic and weaker. This imbalance results in uneven muscle endurance as well as overworked muscles. These muscles are prone to fatigue and underactive muscles failing to provide adequate support. These patients experience back pain along with decreased functional capacity as well as difficulty maintaining proper posture for prolonged periods.[5] All this alteration of biomechanics results in scoliosis, which also affects the magnitude of lumbar extensor muscle activity. Electromyographic views have shown increased muscle activation on the convex side during both static postures and dynamic movements. This overactivity can lead to muscle hypertrophy on one side and atrophy on the other, which can further exacerbate spinal asymmetry. The persistent asymmetrical muscle activation not only decreases endurance but also impacts the coordination and proprioception of scoliosis patients. Patients often find it challenging to perform activities that require spinal stability along with balance. These patients may also feel early fatigue while performing daily activities. Reduction in the endurance of lumbar muscles results in a vicious cycle, which is involved in decreasing the muscle support that further progresses the spinal curvature and further leads to functional limitations. Physiotherapy plays an important role in managing scoliosis as it targets posture along with muscular balance and progression of spinal curvature.[6] Among all the physiotherapy approaches, the growth method has gained quieter limelight and is showing effectiveness in treating idiopathic scoliosis as it addresses the three-dimensional nature of scoliosis. These three-dimensional aspects consist of the nature of scoliosis, rotational angular breathing, and specific posture correction. Rotational angular breathing is to expand the collapsed rib cage area on the concave side, which helps in promoting the symmetry of the chest, along with improvement of respiratory function. The Schroth method also helps in proprioception and exteroceptive stimulation, which further helps in encouraging people to adjust their posture as well as muscle imbalance, which occurs in scoliosis patients.[7] Schroth method enhances the endurance of lumbar extensor muscles, also helps reduce the asymmetry of the spine, and mitigates the progression of the curvature. Idiopathic scoliosis is a problematic disorder that leads to many musculoskeletal and respiratory complications.[8] According to the previous literature, many exercises and equipment are used as a treatment option for idiopathic scoliosis, such as Donosiezwicz technique. Still, the Schroth method has proven to be very effective.[9] Studies have shown its efficacy; for instance, Akçay et al. (2023) found that applying the Schroth standing and sitting posture method significantly improved trunk rotation in idiopathic scoliosis patients.[10] Similarly, David et al. (2023) reported that the Schroth method positively affected ventilation distribution through derotational breathing techniques.[11] Anwar (2025) reported that the Schroth Method significantly reduced Cobb angle, improved postural stability, and enhanced respiratory function in idiopathic scoliosis patients. This study also highlighted psychological benefits, including improved self-image and quality of life, with combined Schroth and bracing interventions yielding superior outcomes.[12] Ayesha Bibi (2023) found that combining bracing with physiotherapeutic scoliosis exercises significantly reduced Cobb angle and improved balance control in adolescents with idiopathic scoliosis.[13] Nadia L. Radwan (2023) found that three months of Schroth exercise therapy significantly improved postural stability and reduced Cobb angle in adolescents with idiopathic scoliosis.[14] There is evidence that the Schroth method improves the Cobb angle; however, little literature is available in support of the Schroth effect for improving lumbar extensor endurance. This study aims to find the effects of the Schroth method on curve magnitude and

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endurance of lumbar extensors in children with idiopathic scoliosis.

2. METHODOLOGY

After the permission of the ethical review board, a single-blinded randomized controlled trial was conducted. The data was gathered from Pakistan Society for Rehabilitation of Differently Abled, Lahore, by using non-probability Convenience Sampling Technique through the fishbowl Method. The calculated sample size was 32 participants, 16 in each group, after adding the 10% attrition rate. It was calculated by using the Epi tool, taking Cobb angle as an outcome variable in a previous study related to idiopathic scoliosis. The mean Cobb angle in group 1 was 33.4 with a variance of 8.9, and in group 2 was 30.3 with a variance of 7.6. A confidence level of 0.95 with 0.8 power was used for the calculations.[15]

The study included participants aged 9 to 17 years of either gender, diagnosed with idiopathic scoliosis with a Cobb angle ranging between 10 and 26 according to X-ray findings.[16] Exclusion criteria were any neurological condition (such as cerebral palsy or Down syndrome), any other orthopedic condition, a surgical history of the spine, or severe systemic disorders.[17]

Selected participants were randomly allocated into two groups by using the Fish bowl method, where the assessor was kept blind. Group A (n = 16), the experimental group, received the Schroth Exercise Therapy.[18] Along with routine physical therapy. Group B (n = 16), the control group, received routine physical therapy alone.

In Group A, participants performed Schroth exercises in addition to routine physical therapy. The Schroth Method exercise program included passive as well as active postural correction exercises. On the kinesthetic and sensorimotor principle, the Schroth exercise was prescribed. Strength, along with endurance training of postural muscles, rotational exercises, breathing exercises, spinal elongation, stretching, and strengthening exercises, was used. For postural adjustment and for providing passive support, rice bags along with foam blocks, stools, and long sticks were used. The intensity of the exercises was gradually increased based on each participant's functional improvement by decreasing passive support, changing positions, and adjusting sets and repetitions. Participants received 30 30-minute sessions with five sessions per week for 4 weeks.[16]

In Group B, participants performed routine physical therapy exercises alone. These exercises included stretching of muscles on the concave side of the spinal curve. Along with this posture training, breathing exercises, spinal flexibility exercises, myofascial release techniques, pelvic tilts, and core strengthening exercises were also given. On progression, the intensity of the exercise program was increased based on people's functional improvement. Each session was 30 minutes daily, with five sessions per week for 4 weeks.[19]

Assessments were conducted at baseline and after the 10th session of treatment, including measurement of the Cobb angle, and for assessing lumbar muscle endurance, the Sorensen test was used.

The curve magnitude was assessed by measuring the Cobb angle, which was calculated by summing the tilt angles of the upper and lower end vertebrae on an X-ray. For measuring the Cobb angle, an imaginary line is connected from the upper and lower vertebrae to the end plate of the film. Afterwards, an angle is calculated from the upper and lower and through the draw-line, based on which two major results are summed for the Cobb angle calculation. The intra-observer reliability of the manual measures for the coronal Cobb angle is high, with an ICC ranging from 0.93 to 0.95.[20]

The Sorensen test was used to determine the endurance of the lumbar extensor muscles by measuring the time participants could maintain an isometric contraction in a prone position with trunk extension. The test was performed on a bench with the participant lying prone, and two therapists supervised the test. One controls the lower extremities, and the other ensures precision and recording time. The participant maintained the horizontal position as long as possible, up to a maximum of 4 min. The test was stopped after two warnings about deviations from the correct position. Time was measured in seconds with a precision of 0.1 seconds. The intra-rater reliability of the Sorensen test is high, with an ICC of 93.2%.[21]

Data were analysed by using SPSS version 27.0. Mean and standard deviation were used to represent continuous data. On the contrary, frequency and percentage were used to represent categorical data. For assessing the normality, the Shapiro-Wilk test was used ($n<50$). Normality test shows that the data were equally distributed as $P > .05$. Based on this parametric test, comparisons were applied.

3. RESULTS

The findings indicated that the study involved two groups: Group A, which consisted of 16 participants. In the intervention group, the average age was 8.81 ± 2.01 years, while in the control group, it was 10.50 ± 2.53 years. Similarly, the average height was 4.02 ± 0.326 feet in the intervention group and 4.13 ± 0.145 feet in the

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Table 1: Independent sample T test between groups analysis

Treatment	Groups	Mean ± SD	Mean Difference	t-statistic	p-value
Sorensen Test Pre-Treatment	Experimental group	179.87 ± 7.05	2.56	1.01	.321
	Control Group	177.31 ± 7.309			
Sorensen Test Post-Treatment	Experimental group	213.25 ± 7.11	1.01	6.80	0.00
	Control Group	198.31 ± 5.16			
Cobb Angle Pre-Treatment	Experimental group	22.69 ± 2.21	-.592	-.592	.559
	Control Group	23.12 ± 1.96			
Cobb Angle Post-Treatment	Experimental group	13.06 ± 1.18	-8.291	-8.291	0.00
	Control Group	18.44 ± 2.31			

Independent sample T test; SM= Schroth Method, P < 0.05 considered as significant; Experimental group (Routine physical therapy + SM); Control Group (Routine physical therapy)

Table 2: Paired sample T test within groups analysis

Tools	Experimental group (Routine physical therapy + SM)		t-value	p-value	Control Group (Routine physical therapy)		t-value	p-value
	Pre-Treatment	Post-Treatment			Pre-Treatment	Post-Treatment		
Sorensen test	179.87 ± 7.05	213.25 ± 7.11	-13.11	0.00	177.31 ± 7.31	198.31 ± 5.16	-10.25	0.00
Cobb Angle	22.69 ± 2.21	13.06 ± 1.18	15.74	0.00	23.12 ± 1.96	18.44 ± 2.31	8.71	0.00

Paired sample T test; SM= Schroth Method, P < 0.05 considered as significant

control group. The average weight was 36.12 ± 7.36 kg in the intervention group and 41.50 ± 7.03 kg in the control group. The results showed that there were 18 (56.25%) boys and 14 (43.75%) girls. A normality test confirmed that the data were normally distributed, leading to the use of parametric tests. An independent sample t-test was used for between-group comparisons, while a paired sample t-test was applied for within-group comparisons.

Table 1 shows no significant difference between pretreatment and post-treatment readings for lumbar extensor endurance and Cobb Angle. However, the Experimental Group combined physical therapy and the Schroth method showed more effectiveness in improving endurance. The Cobb Angle showed no significant difference between pretreatment and post-treatment readings, but the combined group showed more effectiveness (P<0.05).

The within-group analysis showed a significant improvement in curve magnitude (Cobb angle) and lumbar extensor muscle endurance in both groups after treatment (Table 2). However, Group A (Routine physical therapy with the Schroth method) exhibited greater improvement compared to Group B (Routine physical therapy) (P<0.05).

4. DISCUSSION

The present study aimed to evaluate the effectiveness of incorporating the Schroth method into routine physical therapy on lumbar extensor endurance and curve magnitude (Cobb angle) in patients with idiopathic scoliosis. The findings demonstrated that the experimental group, which received both the Schroth method and standard physiotherapy, showed significantly greater improvements in lumbar extensor endurance and a reduction in Cobb angle compared to the control group, which received only routine physical therapy. The result of this study supports the findings of the previous study by emphasising the efficacy of the Schroth method for the management of idiopathic scoliosis. Similarly, in 2022, Radwan et al. Conducted a study to see the different durations of the sloth method for a longer period on the Cobb angle of the Idiopathic scoliosis patient. This study shows that longer duration intervention has more beneficial results in reducing curve magnitude.[14] Although our study has less follow-up time and duration, it still showed a significant

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decrease in Cobb angle in the experimental group as a result of the Schroth method. The findings of our study relate to extensive endurance, supporting the findings of a 2019 study conducted by Jorgic et al. This study reported that the growth method positively impacts the endurance of lumber extensive muscles along with motor functionality among idiopathic scoliosis patients.[14] The significant findings related to Sorensen test scores in our study group showed that the Schroth method effectively strengthens the back muscles, which are held responsible for spinal stabilization. Previous studies have further explored the multifaceted impact of the Schroth method on idiopathic scoliosis patients. Celik et al. in their 2024 study, determined the effect of the Schroth method on Pain, body awareness, and quality of life among idiopathic scoliosis patients. The findings of this study showed a significant reduction in pain severity and pain pressure in the experimental group. On the contrary, no improvement was seen in the quality of life as well as body awareness. The study suggests that the Schroth Method is only effective in reducing pain, severity, and pressure, but it does not affect quality of life or body pressure. This study influences all psychosocial aspects associated with idiopathic scoliosis patients.[8] In their study, Wei et al. (2024) used a combination of the Schroth method along with positioning manipulation in idiopathic scoliosis patients. This study stated that a conventional therapy group where the Schroth method was used alone showed more significant results in improving disability index, pain threshold, quality of life, and Cobb angle, along with clinical efficacy.[22]

This study highlights the importance of the Schroth method as a broader conservative treatment management, which is helpful in optimal patient care of idiopathic scoliosis patients. In comparison to the study in 2024, Tombak et al. evaluated the effect of supervised as well as home-based Schroth method exercise in improving the symmetry as well as the quality of life of idiopathic scoliosis patients. The study showed that both supervised and home-based exercises are equally effective in improving the quality of life, along with symmetry in idiopathic scoliosis patients.[23] The findings of the study showed the accessibility as well as adaptability of the growth method in benefiting the idiopathic scoliosis patient by enhancing adherence and long-term patient-related outcomes.

Khaledi et al. (2024) conducted their study to see the comparative effect of growth method exercise in comparison with a combination of growth method along with spinal stabilisation exercise. This effect was seen on trunk rotation, Cobb angle, and quality of life. It was seen that the combination of the Schroth method along with spinal stabilisation was more effective in improving these parameters.[24] The findings of the study showed that this exercise shortens the superior result by addressing both structural and functional impairment of the idiopathic scoliosis patient. On the contrary, in our study, no comparison or additional therapy was used. Our study faced several challenges in participant recruitment because the patients with idiopathic scoliosis in Pakistan are generally less likely to pursue physiotherapy. Additionally, other factors like involvement in different physical activities from previous physical therapy engagements were not considered in this study, which might have affected the efficacy of the findings. It was recommended to equip and install a proper setup for performing the Schroth method in clinics, so that it is easy to perform the exercise. Future studies can also explore the adherence and patient education related to the Schroth method on different treatment options. Along with this, a community-based cost-effectiveness study can also be conducted by using this intervention. Additionally, community-wide patient awareness programs could be beneficial in increasing the understanding and early detection of scoliosis, potentially leading to earlier interventions and better outcomes. All previous evidence and results of this study state that the integration of the Schroth method into routine physical therapy programs appears to significantly enhance lumbar extensor muscle endurance and reduce curve magnitude in patients with idiopathic scoliosis. These improvements are likely due to the method's targeted approach in correcting muscle imbalances and promoting spinal stability.

5. CONCLUSION

Based on these findings, it is concluded that the Schroth method, along with routine physical therapy, is a more effective treatment to improve curve magnitude and endurance of lumbar extensors among patients with idiopathic scoliosis.

6. Data availability

Numerical data generated in this study is available with the authors.

7. Disclaimer

None to declare.

8. Conflict of interest

None to declare.

9. Source of funding

No external or industry funding was used for the conduct of this study.

10. Authors contribution

SF: Conception and Design

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FA: Collection and assembly of Data
SK: Analysis and interpretation of Data
AM: Drafting of the article; Statistical analysis
KSG: Final approval and guarantor of the Article
AH: Critical revision of the article for important intellectual content

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