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Effectiveness of Schroth and Pilates exercises vs Schroth and Vojta therapy on Cobb angle, angle of trunk rotation, chest expansion and quality of life among adolescents with idiopathic scoliosis -a comparative study

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Abstract

Background: Scoliosis is defined as the lateral curvature of the spine in the upright position. It is a deformity affecting spine in all three planes. In most of the cases the exact cause of the scoliosis is unclear and is more commonly seen in girls in the adolescent age group. Adolescent idiopathic scoliosis presents with a deformity of the back, unequal shoulder levels, waistline asymmetry and a rib cage prominence.

Objectives: The study's primary objective was to find out the effectiveness of Schroth and Pilates exercises versus Schroth and Vojta therapy on Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life among Adolescents with Idiopathic Scoliosis.

Subjects and Methods: A pre-test, post-test comparative study design was used. A criterion-based randomized sampling was used to recruit adolescents with Idiopathic scoliosis (N=30) and they were divided into two treatment groups by using lot method. GROUP A consisted of 15 adolescents and they received Schroth and Pilates exercises whereas GROUP B also consisted of 15 adolescents but they received Schroth and Vojta therapy. Both the groups received the interventions for 5 days in a week for 12 weeks. The efficacy of treatment for Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life were measured through X-ray, Bunnell scoliometer, measuring tape and SRS-22r questionnaire respectively. Both paired and unpaired 't' test was employed to study the treatment effectiveness. A p-value < 0.05 was considered 'significant'.

Result: The resultant of this study shows that there were improvements in both the groups eventually but Group A, which was exposed to the treatment combinations of Schroth and Pilates exercises showed better improvement in Cobb angle (mean difference 19.13), Angle of trunk rotation (mean difference 5.33), Chest expansion at N1, N2, N3 level (mean difference 5.56, 5.3, 5.3 respectively) and Quality of life (mean difference 4.67) than the Group B, that was exposed to the treatment combinations of Schroth and Vojta therapy at 0.05 levels of significance.

Conclusion: Both the groups showed significant improvement in Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life after the application of Schroth and Pilates exercises for group A and Schroth and Vojta therapy for group B for a period of 12 weeks. But comparatively Group A (Schroth and Pilates exercises) showed significant improvement in Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life than Group B (Schroth and Vojta therapy).

Clinical implications: Schroth and Pilates exercises is found to produce better improvement in Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life when compared to Schroth and Vojta therapy in Adolescents with Idiopathic Scoliosis.

Keywords: Idiopathic scoliosis, schroth exercises, pilates exercises, vojta therapy, cobb angle, angle of trunk rotation, chest expansion, quality of life

Introduction

Scoliosis is a complex three-dimensional deviation of the spinal axis^[1]. The word Scoliosis is derived from the Greek word 'Skoliosis' meaning crooked^[2]. It was first established by Greek physicians Hippocrates (A.D.460-370) and Galen (130-201 AD). Scoliosis is a deformity that encounter all the three planes where there is a lateral bending of the spine in the frontal plane, rotation of vertebrae in the horizontal plane and flattening of the spine in the sagittal plane^[3]. Scoliosis is the lateral curvature of the spine in the upright position^[4]. It may be developed as a single primary curve (resembling the letter C) or as two curves (a

primary curve along with a compensatory secondary curve that forms a S shape). The prevalence of Adolescent Idiopathic Scoliosis ranges from 0.47% to 5.2% worldwide [5-7]. Prevalence of scoliosis in India has been reported from Patiala city of Punjab (0.13%) and Assam (0.2%) [8]. The proportion of Idiopathic Scoliosis is 80% among scoliosis, mainly in adolescent girls [9]. The incidence of female was 1.44 times higher than for males. The female to male ratio ranges from 1.5:1 to 3:1 and increases substantially with increasing age, curve and pattern [5]. According to aetiology, the scoliosis can be distinguished into two principal forms: congenital scoliosis and acquired scoliosis. The congenital scoliosis reflects anomalous development in utero and are due to congenital abnormalities such as failure of formation (wedge, hemi vertebrae), failure of segmentation (unilateral bar, fusion), myelomeningocele, meningocele spinal dysraphism.

The acquired scoliosis is divided into two groups

a) **Secondary scoliosis:** It is of known aetiology. It can be due to neuromuscular (poliomyelitis), myopathic, mesenchymal, metabolic nutritional and endocrine disorders, traumatic causes (such as fracture or dislocation, deformities following thoracoplasty, neurofibromatosis, osteochondrodystrophies), Scheuermann's disease, Ehlers-Danlos disease, infection, tumors (cord tumors), syringomyelia and rheumatoid diseases.

B) **Idiopathic scoliosis:** In most of the cases the exact cause of the scoliosis is unclear [10]. The symptoms of scoliosis typically include uneven shoulders, uneven hips, bumps in the lower back, numbness, weakness, pain in the leg, trouble walking, trouble standing up straight, lethargy, shortness of breath and height loss. Occasionally back pain, not a typical finding in AIS may be reported [11]. There is a complaint of visible prominence of the posterior chest wall and scapula on one side. In thoracic curves, there is a dorsal angulation of the ribs producing the rib hump. In the lumbar region, there is bulging of the lumbar muscles. There is prominence of the pelvis on convex side. Other red flags include severe pain (night pain), untoward stiffness, deviation to one side during the forward bend test, sudden rapid progression in a previously stable curve, extensive progression in a patient after skeletal maturity and abnormal neurologic findings. The most typical presentation of AIS is a right-sided thoracic curve in a female patient, which is pain less, without any abnormal neurological findings.

The main treatment options for scoliosis are:

Observation, Orthosis (bracing), Physiotherapy management and Operative treatment. The selection of the best treatment is based on the maturity of the patient, location, severity and risk of progression of the curvature. Scoliosis is generally associated with a lateral deviation from the normal vertical direction and mostly with rotation of vertebrae. The ribs follow the rotation of the vertebra. All these can be attributed to the fact that due to the complex relationship between the spine, sternum and ribs, the displacement and rotation of vertebrae in the scoliosis affect the shape of the chest wall causing either convexity or concavity. Furthermore, the expansion of the thoracic cavity will be limited because the motion of ribs prevents its mobility. Therefore, the chest wall motion diminishes and breathing becomes significantly more difficult. Various physiotherapy interventions are available to treat Adolescent Idiopathic

Scoliosis such as Schroth physiotherapy scoliosis specific exercises, core stabilisation exercises, stretching, massage, Scientific Exercises Approach to Scoliosis (SEAS) exercises, Klapp exercises, DoboMed approach, Side shift, Lyon exercises, postural training, manipulation, Schroth exercises, Pilates exercises and Vojta therapy are applicable for the treatment of Idiopathic Scoliosis. Deep breathing exercises and active range of motion exercise to the spine. Other techniques include electrical stimulation of muscles, reorganisation of phasic tonic posturing [12]. The Schroth method demonstrated positive outcomes on back muscle strength, breathing function, slowing curve progression, improving Cobb angle and decreasing the prevalence of surgery. Pilates exercises improves flexibility and overall physical health by emphasizing strength, posture and coordination of movements associated with respiration. Vojta therapy activates the patient's whole body to achieve better posture and more precise movements.

Methodology

Study design: A Comparative study design, with pre-test and post-test evaluation was used with two different intervention groups to assess the effectiveness of Schroth and Pilates exercises versus Schroth and Vojta therapy on Cobb angle, Angle of Trunk rotation, Chest expansion and Quality of life among adolescents with Idiopathic Scoliosis.

Subjects: Adolescents with Idiopathic Scoliosis visiting Ashwin Multispecialty Hospital, Coimbatore, Tamil Nadu state formed the population for the study. 30 adolescents were selected based on the selection criteria. Before starting the session, the instructions were given to the adolescents. The criteria adopted to include the adolescents with Idiopathic scoliosis consists of: (i) Age Group- 10-17 years; (ii) Gender – both males and females; (iii) Moderate scoliosis-A Cobb angle between 25 and 45 degrees; (iv) Structural scoliosis; (v) No prior treatment.

Methods: After obtaining the informed consent, adolescents were randomized into two groups by randomized sampling technique using lot method. GROUP A consisted of 15 adolescents, and they received Schroth and Pilates exercises. GROUP B consisted of 15 adolescents and they received Schroth and Vojta therapy. Both the groups received the interventions for 5 days in a week for 12 weeks. In order to study the effectiveness of the therapeutic interventions, four outcome parameters were chosen. These include Cobb angle measured by X-ray, angle of trunk rotation measured by Bunnell scoliometer using Adams forward bend test, Chest expansion was measured at three anatomical landmarks that includes N1: the sub axillary, N2: nipple line, N3: around the waist by measuring tape. The Quality of life was evaluated by using SRS-22r questionnaire. The questionnaire is designed as a disease specific instrument to measure health related quality of life in patients with adolescent idiopathic scoliosis. It totally comprises of 22 questions with 5 options to choose answer from. The measure covers five dimensions: Function, Pain, Self-image, Mental Health and Satisfaction with treatment. Best score is 5 and worst score is 1.

Description of interventions

Schroth exercises

The Schroth method first appeared in 1921, developed by German physiotherapist Katharina Schroth, who had scoliosis herself. Schroth method is a three-dimensional

approach. It includes three components: posture, strengthening and breathing. The treatment is an individualised program and it is based on kinaesthetic and sensorimotor principles.

For adolescents with thoracic scoliosis: Thoracic spine correction, Hanging, stretching on the weak side (concave side of the scoliosis curve), Sitting on the Swiss ball, Strengthening the back muscles and side stretching (Concave side).

For adolescents with lumbar scoliosis: Lumbar spine correction, Lifting the pelvis laterally, Hanging, stretching on the weak side (concave side of the scoliosis curve), Strengthening the back muscles and side stretching (Concave side)

For adolescents with Thoracolumbar scoliosis or double scoliosis: Basic correction sitting, Hanging, Stretching the weak side, Strengthening the back muscles, Thoracolumbar

spine correction.

The Schroth exercises were applied in accordance with the bending shape of each subject, along with three dimensional Schroth rotational breathing.

Schroth rotational breathing: Focused expansion of the flattened portion of the ribs during inspiration, and forced contraction of the rib hump on exhalation.

Duration: 7 repetitions × 2 sets, 60 minutes per day, 5 days per week for 12 weeks.

Pilates exercises

This method was developed by Joseph Pilates in 1923 for the purpose of Rehabilitation [24]. It involves exercises that seek harmony between body and mind. The principles of Pilates exercises are: centering, control, precision, fluidity of movement, concentration and breathing [25]. Pilates exercises is a whole-body approach. The exercises included were:

WEEK 1-4	WEEK 5-8	WEEK 9-12
Back hyperextension	Flex the shoulder and raise the leg in supination.	Lower back muscle stretch
Back hyperextension from Y prone position	Scapula pushups in standing position	Runners stretch
Back hyperextension from T prone position	Body bridge	Abdominal crunch
Arm and leg rise in prone position	Body bridge with ball	Double leg Abdominal press
Quadruped arm/leg raise	Cat and Camel exercises	Cross arm and hip flex abdominal strength
Back hyperextension with hands forward	Stretch side	Finding pelvic floor

Proper breathing was encouraged throughout the exercises. Movements were synchronized with breaths.

Duration: 7 repetitions × 3 sets, 20 minutes per day, 5 days per week for 12 weeks.

Vojta therapy

A child Neurologist Professor Dr. Vaclav Vojta discovered a therapy treatment and developed the so called Vojta therapy during 1954 to 1969. It includes:

Reflex rolling

Phase 1

Patient position

1. Supine lying.
2. Arms and leg extended.
3. Rotation of head is resisted by therapist.

Stimulus

- Acromion
- Breast zone in the intercostals space (7th/8thribs) beneath the nipple on the Mamillary line.

Response

- Extension of the spine
- Flexion of the hip, knee and dorsiflexion of ankle.

Phase 2

Patient position

Side lying

Stimulus

- Acromion
- Anterior superior iliac spine

Response

- The underlying upper arm and leg support the body.
- Extension of the spine during the entire rolling sequence.

The movement ends when the rolling sequence is completed in crawling.

Reflex creeping (Crawling)

Patient position

Prone Lying

Stimulus

The stimulation is given to the following:

- Acromion
- Anterior superior iliac spine
- Lateral process of calcaneal tuberosity

The head resting on bed side or rotated to one side. Movement predominantly ensues the cross pattern in which the right leg and left arm or vice versa move simultaneously.

Response

A leg, its contralateral arm supports the body and move the trunk forward.

Duration: 20 minutes per day, 5 days per week for 12 weeks.

Statistical analysis

The result was analysed for pre and post-test values of Group A and Group B using Student's 't' test favoured for alternate hypothesis. Pre-test and Post-test values were calculated using paired 't' test at 5% level of significance at 14 degrees of freedom with table t value of 2.145. In Between group analysis t value was calculated by unpaired 't' test at 5% level of significance at 28 degrees of freedom with table t value of 2.048.

Results

The demographical presentation of subjects is shown in table 1. Group A consisted of 9 females and 6 males, while Group B consisted of 10 females and 5 males.

Table 1: Demographic characteristics of the subjects

Variables	Group a		Group b	
Age	10-13 years=8	53%	10-13years=9	60%
	14-17 years=7	47%	14-17 years=6	40%
Gender (M/F)	9 females	60%	10 females	67%
	6 males	40%	5 males	33%

to statistical treatment using Students t-test, and the obtained t value is less than the required t table value at 0.05 levels. Hence t is inferred that the mean scores of all the dependent variables consisting of Cobb angle, angle of trunk rotation, chest expansion and quality of life were identical at the Pre-intervention stage before being subjected to therapeutic interventions.

The outcome measures, pre-treatment scores were subjected

Table 2: Comparison of Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life among adolescents with Idiopathic in both Group A and Group B during the preintervention stage.

Outcome Parameter	Groups	Mean	SD	T-value*
Cobb angle	Group A	33.4	2.87	0.000
	Group B	33.4	2.39	
Angle of trunk rotation	Group A	10.13	1.12	0.000
	Group B	10.13	1.19	
Quality of life	Group A	2.3	0.27	0.462
	Group B	2.3	0.29	
Chest expansion at N1	Group A	2.5	0.18	0.000
	Group B	2.5	0.17	
Chest expansion at N2	Group A	2.46	0.13	0.152
	Group B	2.49	0.08	
Chest expansion at N3	Group A	2.5	0.19	0.000
	Group B	2.5	0.19	

*Non-significant at 0.05 levels ($p > 0.05$)

Further exploration was made to ascertain whether any significant difference was observed in the dependent variables between the two-time intervals (i.e., pre-treatment phase and at the end of 12 weeks) in both groups. As a result, it is found that both groups showed a significant

improvement in the Cobb angle, Angle of trunk rotation, chest expansion and Quality of life between the pre-intervention phase and at the end of the twelve weeks of the intervention phase at 0.05 levels significance as shown in table 3.

Table 3: Comparison of Cobb angle, Angle of trunk rotation, chest expansion and Quality of life in adolescents with Idiopathic scoliosis among the two groups between the pre-intervention and post-intervention phase.

Dependent variable	Groups	Pre-intervention stage		Post intervention stage		T-value*
		Mean	SD	Mean	SD	
Cobb angle	Group A	33.4	2.87	19.13	3.46	28.152
	Group B	33.4	2.39	24	3.31	13.672
Angle of trunk rotation	Group A	10.13	1.12	5.33	0.76	16.294
	Group B	10.13	1.19	7	0.95	13.027
Quality of life	Group A	2.306	0.27	4.67	0.14	17.97
	Group B	2.26	0.29	3.46	0.21	10.135
Chest expansion at N1	Group A	2.59	0.18	5.56	0.45	9.352
	Group B	2.58	0.17	4.406	0.47	8.053
Chest expansion at N2	Group A	2.46	0.13	5.306	0.41	10.825
	Group B	2.49	0.08	4.33	0.52	6.258
Chest expansion at N3	Group A	2.53	0.19	5.33	0.45	13.134
	Group B	2.52	0.19	4.21	0.47	10.675

*Significant at 0.05 levels ($p < 0.05$)

Further, a significant difference is observed between the two groups while analysing the effect therapeutic intervention on the four dependent variables such as Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life.

Furthermore, while considering the mean score of all the outcome variables, group A is better than the Group B (Table 4).

Table 4: Comparison of Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life among adolescents with Idiopathic in both Group A and Group B during the postintervention stage

Outcome Parameter	Groups	Mean	SD	T-value*
Cobb angle	Group A	19.13	3.46	2.141
	Group B	24	3.31	
Angle of trunk rotation	Group A	5.33	0.76	2.53
	Group B	7	0.9	
Quality of life	Group A	4.67	0.14	8.692
	Group B	3.46	0.21	
Chest expansion at N1	Group A	5.56	0.76	9.352

	Group B	4.406	0.47	
Chest expansion at N2	Group A	5.306	0.41	10.825
	Group B	4.33	0.52	
Chest expansion at N3	Group A	5.33	0.45	13.134
	Group B	4.21	0.47	

*Significant at 0.05 levels ($p < 0.05$)

From table 4, it is inferred that the group A, which was exposed to the treatment combinations of Schroth and Pilates exercises showed a better reduction in Cobb angle (mean difference 19.13), Angle of trunk rotation (mean difference 5.33), Chest expansion at N1, N2, N3 level (mean difference 5.56, 5.3, 5.3 respectively) and Quality of life (mean difference 4.67) than the Group B, that was exposed to the treatment combinations of Schroth and Vojta therapy at 0.05 levels of significance.

Result

The statistical analysis showed that the calculated 't' value using the paired 't' test in group A and group B for Cobb angle were 28.152 and 13.672, Angle of trunk rotation were 16.294 and 13.027 and Quality of life were 17.97 and 10.135 respectively which was greater than the table value of 2.145 with $p < 0.05$. When comparing between the group using unpaired 't' test, the calculated 't' value of post-post comparison of Cobb angle was 2.141, Angle of trunk rotation was 2.53 and Quality of life was 8.692 which was greater than the table value of 2.048 with $p < 0.05$.

The statistical analysis showed that the calculated 't' value using the paired 't' test for chest expansion at N1, N2, N3 level in group A and group B were 9.352, 10.825, 13.134 and 8.053, 6.258, 10.675 respectively which was greater than the table value of 2.145 with $p < 0.05$. When comparing between the group using unpaired 't' test, the calculated 't' value of post-post comparison of Chest expansion at N1, N2, N3 level were 9.352, 10.825, 13.134 respectively which was greater than the table value of 2.048 with $p < 0.05$.

Thus, the resultant of this study shows that there were improvements in both the groups eventually, but Group A (Schroth and Pilates exercises) showed more statistically significant improvement when compared to Group B (Schroth and Vojta therapy).

Discussion

Adolescent Idiopathic scoliosis (AIS) is a three-dimensional deformity of the vertebral column, marked by the rotation of the vertebral bodies and deviation in the coronal plane of 10 degrees. Spinal shift occurs in all three planes followed by muscle dysfunction and reduced vital capacity of the lungs. Its manifestation occurs predominantly between 10 and 18 years. It generates a large impact in physical and psychosocial aspects. Early intervention throughout pubertal development can prevent or stop deformity progression and even partially correct this deformity at times

In 2020, Shkurta Rrecaj-Malaj et al., conducted a study on combined outcome of Schroth and Pilates Exercises on Cobb Angle, Angle of trunk rotation, Chest expansion, Flexibility, Quality of life in Adolescents with Idiopathic Scoliosis. Sixty-nine adolescents with Idiopathic scoliosis aged 10-17 years, presenting with a Cobb angle of 10-45° were enrolled in this study. The treatment protocol included selected exercises from Schroth and Pilates methods which was performed over 24 weeks and consisted of 2 periods of 2-week treatment regimens performed daily for 60 minutes.

Each of treatment periods was then followed by the same home program treatment for 10 weeks. Cobb angle (X-rays), ATR (Scoliometer), chest expansion (cm), trunk flexion (cm) and QoL (SRS-22r questionnaire) were assessed. This study showed that combined exercises provided benefit on the Cobb angle, ATR, chest expansion, trunk flexion and QoL in adolescents with mild and moderate idiopathic scoliosis.

In 2017, Rata Marinela, et al., did a study on the combined efficiency of the Vojta and Schroth therapies for recovering the adolescents with scoliosis. The research was performed on three female subjects, aged between 11 and 13 years old. Following the assessment and individualized physical therapy programs, they confirmed that exercises from Schroth and Vojta therapies will improve the patients posture and will give a better functionality of the spine. The results demonstrated that the two forms of therapy are effective, obtaining 6 to 20-degree improvements in the Cobb angle.

The previous studies demonstrated the combined effectiveness of Schroth with Pilates exercises and Schroth with Vojta therapy. The present study has demonstrated the effectiveness of Schroth and Pilates exercises versus Schroth and Vojta therapy to improve Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life in adolescents with Idiopathic Scoliosis.

The Schroth exercises consist of activity of daily living exercises with rotational breathing for derotation and deflexion of the vertebrae aiming to correct spinal deformity. Correction of the curve pattern is achieved through combinations of stretching, strengthening and breathing in reverse directions of all existing abnormal curvatures. The exercises encourage neurodynamic of the patient to change motor control. It is based on sensorimotor and kinaesthetic principles and incorporates corrective therapeutic exercises, special breathing techniques, and re-education of the neuromuscular system. Schroth exercise has the advantage of correcting the posture according to the bending type and is an effective mechanism to facilitate the correction posture in the 3 dimensions of scoliosis. The exercises include a combination of forces that produce external forces on the vertebral column. The initial external force involved in every Schroth exercises elongation. Using sensorimotor feedback mechanisms, the patients learn individual correction routine. Pilates exercises includes cognizant utilization of trunk muscles to balance out the lumbo-pelvic area, and the technique is intended to improve mobility and general body well-being by accompanying coordination, strength and respiratory exercises. Pilates exercises training has been reported to improve flexibility and overall physical health by emphasizing strength, posture and coordination of movements associated with respiration. Pilates exercise training has been reported to be effective in improving scoliosis by correcting poor posture, strengthening the muscles necessary for postural correction and maintaining body balance. Vojta therapy is said to activate innate stored movement patterns. With repeated

activation, the plasticity of the CNS is able to normalise the autonomic posture of the body and the righting balance reflexes which enables and stabilizes the involvement of spontaneous motor skills. Vojta reflex locomotion has been reported to activate trunk and the deep muscles of the spine to regulate trunk stability and increase spinal rotation force, thereby enhancing postural control. By repeating the stimulation, the previously blocked connections between the muscle and the brain become available enabling the patient to perform these movements without any external stimulation. This method serves to restore normal motor patterns and correct postural defects through the use of both fundamental system of facilitation to produce a change in the position of the COG and help the patient assume an erect position, maintain body balance and a coordinated posture. The results of previous studies reported that at least one to three months of continuous exercise is necessary to obtain positive effects of Schroth exercises. The effect size become larger as the Schroth exercises duration increased. In Vojta therapy, repetitive stimulation of specific parts of the body is used to activate the innate ideal patterns which then appears as spontaneous movements. The therapy must be applied for at least several weeks and can even extend up to many years.

The result was analysed for pre and post-test values of Group A and Group B using Student's 't' test favoured for alternate hypothesis. Pre-test and Post-test values were calculated using paired 't' test at 5% level of significance at 14 degrees of freedom with table t value of 2.145. In Between group analysis t value was calculated by unpaired 't' test 5% level of significance at 28 degrees of freedom with table t value of 2.048. The obtained t value was greater than the table t value in within group analysis for both Group A and Group B. The obtained t value was greater than the table t value in between group analysis for post-post comparison. Hence, the alternate hypothesis is accepted.

To sum up the findings, comparing the pre-test and post-test analysis of Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life within each group, show significant improvement in all outcome parameters. However, on analysing the post-test result of group A and group B, both the group has statistical improvement in the Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life after the application of interventions but comparatively Group A (Schroth and Pilates exercises) showed significant improvement than Group B (Schroth and Vojta therapy) in Adolescents with Idiopathic Scoliosis.

Limitations

The study did not include a control group.

The comprehensive literature also uses the Risser scale to determine skeletal maturation, which was not used in this study.

The study requires a longer follow-up.

Further directions of the study

Having a control group is desirable.

Long term benefits can be employed to make the results more reliable.

Further studies can be done with other types of scoliosis.

Further studies can be done based on different outcomes.

Conclusion

The study concluded that, both the groups showed statistically significant improvement in Cobb angle, Angle of trunk rotation, Chest expansion and Quality of life among adolescents with Idiopathic Scoliosis after the application of Schroth and Pilates exercises for Group A and Schroth and Vojta therapy for Group B for a period of 3 months. But Group A (Schroth and Pilates exercises) showed significant improvement when it was compared with Group B (Schroth and Vojta therapy).

The present study adds value to the literature that Schroth and Pilates exercises when compared with Schroth and Vojta therapy showed better improvement in Cobb angle, Angle of trunk rotation, chest expansion and Quality of life among adolescents with Idiopathic scoliosis.

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