

ROLE OF POSTURAL CORRECTION BRACE ALONG WITH CORRECTIVE EXERCISES IN IMPROVEMENT OF FUNCTIONS AND QUALITY OF LIFE IN ADOLESCENT IDIOPATHIC SCOLIOSIS- RANDOMISED CONTROLLED TRIAL

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ABSTRACT

BACKGROUND

Scoliosis is lateral curvature of spine with torsion of the spine and chest resulting in a disturbed sagittal profile. The exact cause of Adolescent Idiopathic Scoliosis (AIS) is unknown, but it may be due to combination of genetic and environmental factors. Conservative measures of treatment for AIS are exercises, braces and postural education. The aim of this randomised control study was to assess the effect of adding a brace and postural correction to spinal scoliosis correction exercises on one year outcome of treatment of AIS. Objectives of the study were to assess the effects of adding a brace and postural correction to spinal scoliosis correction exercises on angle of trunk rotation and health-related quality of life in AIS.

MATERIALS AND METHODS

Thirty two patients of AIS who met the eligibility criteria were enrolled in the study. Both the groups undertook self-correction exercises (spinal extension and spinal stretching exercises). Braces and postural correction were added to the experimental group. Effects were assessed after one year using scoliometry for measurement of Angle of Trunk Rotation (ATR) and SRS-22 was used to assess health-related quality of life.

RESULTS

ATR was found to be significantly ($p=0.02$) lower in the Experimental group compared to Control group at one year follow up. A significant ($p<0.05$) difference in the quality of life parameters was also observed at one year follow up in the experimental group compared to control group, the experimental group showing higher improvement.

CONCLUSION

Adding brace and postural correction to spinal scoliosis correction exercises improves one year outcome measured in terms of ATR and health-related quality of life.

KEYWORDS

AIS- Adolescent Idiopathic Scoliosis, Self-Correction Exercises, Brace.

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BACKGROUND

Scoliosis is lateral curvature of spine with torsion of the spine and chest as well as disturbance in the sagittal profile.^[1] Cobb has defined it as a lateral curvature of the spine on the frontal plane greater than 10° when measured on a standing radiograph using the Cobb's method.^[2] Adolescent Idiopathic Scoliosis (AIS) is defined as a lateral curvature of spine in an otherwise healthy child for which a currently recognisable cause has not been found.

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The prevalence of AIS when defined as a curvature greater than 10 degrees according to Cobb is 2-3%.^[3] The exact cause of AIS is unknown, but it may be due to combination of genetic and environmental factors.^[4] There is often a positive family history, but the pattern of inherited susceptibility is not clear. Current information is suggestive of genetic heterogeneity.^[5]

The deformity in AIS appears during the adolescent growth spurt. In most of the cases, the deformity does not progress. However, in some, it does progress. Progression is more likely to happen in pre-pubertal girls than boys.^[6] The primary aim of treatment in adolescents is to reduce progression of the curve.^[7] In order to decrease the risk of back pain, disability, breathing insufficiency and cosmetic problems with consequential improved health-related quality of life in adulthood.

Patients presenting with thoracic curves less than 25 degrees or thoracolumbar curves less than 20 degrees are



conventionally managed with spinal scoliosis correction exercises only.

Brace is added to the treatment if the curve increases to more than 25 degrees for thoracic curves and 20 degrees for thoracolumbar curves.^[6] The exercises prescribed are active exercises and breathing exercises. The active exercises prescribed are self-correction, spinal strengthening and spinal mobilisation exercises.

HYPOTHESIS

The use of a brace in combination with spinal scoliosis correction exercises will significantly improve outcome in AIS patients with thoracic curves <25 degrees or thoracolumbar curves <20 degrees.

Aim of the Study

To assess the effect of spinal scoliosis correction exercises and use of brace on one year outcome of adolescent idiopathic scoliosis (defined as curves <20 degrees for thoracolumbar region and <25 degrees for thoracic region).

METHODOLOGY

Study Design

Randomised Control Study.

Target Population

AIS patients with thoracic curves <25 degrees or thoracolumbar curves <20 degrees.

Study Population

Mild AIS patients with thoracic curves <25 degrees or thoracolumbar curves <20 degrees presenting to the OPD of Orthopaedics and PMR Departments of KGMU.

Study Period

One Year (from November 2014 to October 2015).

Sample Size

Total 32 subjects of AIS were enrolled. The sample size required in each groups was 16 as calculated by the formula (Hayes and Bennet, 1999).^[8]

$$n = 7.84 \times (\sigma_0^2 + \sigma_1^2) / (\mu_0 - \mu_1)^2$$

n=sample size per group.

σ-Standard deviation.

μ-mean value.

Eligibility Criteria

- Eligible subjects were from the age group of 10-15 years diagnosed as fixed AIS with Cobb's angle <25° for thoracic curves and <20 degrees for thoracolumbar curves subject to written informed consent. Subjects excluded from the study were those having.
 - AIS with correctable deformity.
 - Any pathology and/or deformity of lower limbs disturbing spinal posture.
 - Systemic illness or cardiorespiratory dysfunction.
 - Subjects who have undergone spinal surgery or rehabilitation elsewhere.
 - Cognitive impairment.

Setting

The study was conducted at Department of Physical Medicine and Rehabilitation and Department of Orthopaedics, KGMU, UP. KGMU is the only centre in Uttar Pradesh that has a PMR Department, which in conjunction with the Orthopaedics Department and physiotherapy unit of KGMU provides comprehensive rehabilitative services to patients of scoliosis.

Thirty two were enrolled in the study. Microsoft XL was used to generate a random number table. Patients were allocated to two groups by a departmental colleague who was not involved in the study. This was done to ensure allocation concealment. All patients were randomly allocated to control group and experimental group using the random number table. Patients were not aware of the group to which they are being allocated. All patients enrolled in the study was assessed for baseline data that included.

1. Age.
2. Sex.
3. Angle of Trunk Rotation measurement by Scoliometer.
4. Quality of life estimation by region specific Scoliosis Research Society - 22.

Intervention

Control Group

All the subjects included in control group underwent following exercise regimen for a period of one year in the physiotherapy unit of KGMU.

- Active Exercises-Self correction exercises, spinal mobilisation and strengthening exercises.
- Breathing exercises.

Experimental Group

Subjects in the experimental group underwent the following exercise regimen for a period of one year in the physiotherapy unit of KGMU.

- Active Exercises-Self correction exercises, spinal mobilisation and strengthening exercises.
- Breathing exercises.
- Postural correction by active correction and use of brace.

Outcome Measures

Both the groups were assessed by a blinded observer at 6 monthly follow ups for,

1. Angle of Trunk Rotation measurement by Scoliometer.
2. Quality of life estimation by SRS-22.

Statistical Analysis

The results are presented in mean±SD and percentages. The chi-square test was used to compare the gender differences between Experimental and Control groups. The age and ATR was compared between Experimental and Control groups by using unpaired t-test. The quality of life parameters were compared by using nonparametric test such as Mann-Whitney U test. The intragroup comparisons were carried out by paired t-test/Wilcoxon rank-sum test whenever applicable.

The p-value <0.05 was considered significant. All the analysis was carried out on SPSS 16.0 version (Chicago, Inc., USA).

RESULTS

Sixteen patients each were enrolled in Experimental and Control groups. The age and sex distribution were found to be similar ($p>0.05$) in both the groups, which demonstrates the success of randomisation and comparability of the two groups (Table-1).

Age and Sex	Experimental Group (n=16)	Control Group (n=16)	p-value
Age in years, mean±SD	12.06±1.76	11.75±1.43	0.58 ^a
Sex, No. (%)			
Male	10 (62.5)	10 (62.5)	1.00 ^b
Female	6 (37.5)	6 (37.5)	

Table 1. Age and Sex Distribution between Experimental and Control Group

^aUnpaired t-test, ^bchi-square test

There was no significant ($p>0.05$) difference in the ATR between the groups at pre-treatment. ATR was found to be significantly ($p=0.02$) lower in the Experimental group compared to Control group at post treatment. The intragroup comparisons showed that there was significant ($p=0.0001$) decrease in ATR from pre to post treatment in both the groups, however, the decrease was observed to be higher in Experimental group (3.43 ± 0.62) than Control group (1.75 ± 0.57) (Table-2).

ATR	Experimental Group (n=16)	Control Group (n=16)	p-value ¹
Pre	9.44±1.50	9.06±1.56	0.49
Post	6.00±1.36	7.71±1.77	0.02*
Mean change	3.43±0.62	1.75±0.57	
p-value ²	0.0001*	0.0001*	

Table 2. Comparison of ATR between Experimental and Control Group

¹Unpaired t-test, ²Paired t-test

Table-3 shows the comparison of quality of life parameters between Experimental and Control group. There was no significant ($p>0.05$) difference in all the quality of life parameters at pre-treatment between the groups. A significant ($p<0.05$) difference in the quality of life parameters was observed at post-treatment between Experimental and Control group being higher in Experimental than Control group. The intragroup comparison showed that there was significant ($p<0.01$) increase in all the quality of life parameters in both

Experimental and Control groups, however, the increase was observed to be higher in Experimental group compared to Control group.

Parameters	Experimental Group (n=16)	Control Group (n=16)	p-value ¹
Function			
Pre	2.62±0.44	2.87±0.61	0.28
Post	4.05±0.21	3.45±0.53	0.0001*
Mean change	1.42±0.46	0.57±0.46	
p-value ²	0.0001*	0.003*	
Pain			
Pre	2.46±0.20	2.45±0.40	0.44
Post	3.85±0.34	3.21±0.31	0.0001*
Mean change	1.38±0.49	0.76±0.48	
p-value ²	0.0001*	0.001*	
Mental Health			
Pre	2.86±0.46	3.08±0.41	0.18
Post	3.75±0.40	3.40±0.48	0.04*
Mean change	0.88±0.41	0.31±0.23	
p-value ²	0.0001*	0.001*	
Self-Perceived Image			
Pre	2.56±0.35	2.76±0.10	0.11
Post	3.51±0.32	3.10±0.14	0.0001*
Mean change	0.95±0.38	0.33±0.14	
p-value ²	0.0001*	0.001*	
Satisfaction with Management			
Pre	2.03±0.12	2.00±0.00	NA
Post	3.95±0.51	2.68±0.79	0.0001*
Mean change	1.91±0.58	0.68±0.79	
p-value ²	0.0001*	0.003*	

Table 3. Comparison of Quality of Life Parameters between Experimental and Control Group

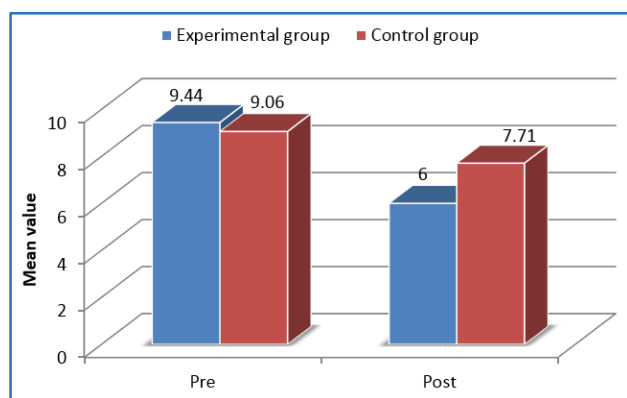
¹Mann-Whitney U test, ²Wilcoxon rank-sum test, *Significant

DISCUSSION

There was no significant distribution in the age and sex distribution of the patients in the Experimental and Control groups, which demonstrates the success of randomisation.

We have found a significant improvement in the conventional group. The jury is still out as to whether exercise is an effective method of treatment for AIS. Results reported in literature are conflicting. A systematic review of all conservative interventions in the treatment of AIS published by Lenssinck et al^[9] concluded that the effectiveness of exercise therapy is not yet established, but might be promising. Another review study on efficacy of exercise therapy for treatment of AIS by Simon et al^[10] failed to find robust evidence in support of exercise therapy in the treatment of AIS.

However, there a number of studies that have endorsed exercise therapy as an effective treatment option and have purpose built rehabilitation centres specifically for this use. An initial review of 11 papers by Neigrini et al concluded that there was no fool proof evidence either in support of or against the role of exercise therapies in decreasing the rate of curve progression in AIS.^[11] A subsequent updated review by the same author included 8 more papers and concluded that all studies excepting one confirmed the efficacy of exercises in AIS.^[12] On the other end of the spectrum is another review,^[13] which found evidence to support physiotherapy and rehabilitation programs in AIS.

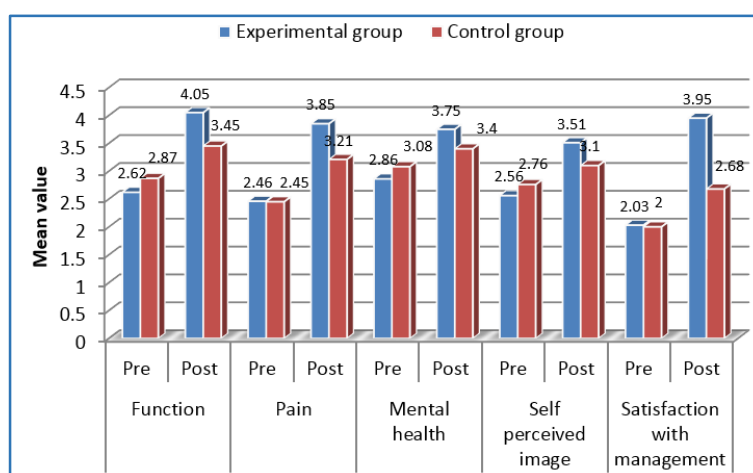


Bar Graph Showing the Results of Changes in ATR

Several studies of bracing in AIS have suggested that bracing decreases the risk of curve progression.^[14,15,16,17,18] However, the results were inconsistent and the studies were limited due to their observational nature and only one prospective study enrolled both patients who underwent bracing and those who did not.^[19] A landmark study by Stuart L. Weinstein et al,^[20] which enrolled patients using randomised cohort and preference cohort techniques has reported that bracing significantly decreases the progression of high risk curves to the threshold for surgery in patients with AIS. They also reported that the benefit of using a brace was associated with longer hours of wear, which was also associated with higher rates of successful treatment. A study by A.L. Nachemson et al^[19] reported that long-term treatment of AIS with brace showed better success rate when compared with observation or surface electrical

stimulation only. It was a prospective, multicentre, multinational, centre specific study that reported results at 4 year follow up. It is considered as one of the best studies on long-term efficacy of bracing. However, the study was limited by a 14% loss to follow up and involved only thoracic curves. Marc A Asher and Douglas C Burton^[21] reported that the effectiveness of nonoperative treatment using braces is limited in curves between 25 degrees to 40 degrees. They concluded that bracing appears to prevent about 20% to 40% of appropriately braced curves from progressing 6° or more. However, they did not use any sort of exercises along with bracing. Our findings are supported by a meta-analysis of 20 studies that showed that the weighted mean proportion of success was 0.39 for lateral electrical surface stimulation, 0.49 for observation and 0.60, 0.62, and 0.93 for bracing 8, 16 or 23 hours per day, respectively. The last was significantly more successful than any other treatment, $P < 0.000$ ^[22] whether bracing program can reduce the need for surgery is question that still needs to be answered. However, promising results have recently been reported from two different centres using similar programs combining custom bracing and intensive inpatient rehabilitation. They have reported a reduction of at least 50% in the requirement of surgery.^[23,24] However, the studies are limited in the sense that they have used published series for comparison.

Exercise is reported to improve quality of life in patients with AIS. Marco Monticone et al 2013^[6] have reported that a program combining active self-correction and task-oriented exercises as well as traditional exercises were effective in enhancing the health-related quality of life in patients with AIS. They also reported the combination of active self-correction and task-oriented exercises to be superior to traditional exercises. We have reported significantly higher improvement in health-related quality of life parameters in the experimental group. This is in contrast with the study by Weinstein et al^[20] who reported no significant difference in the Peds QL^[25] score in patients treated by bracing and observation. The parameters evaluated were function, pain, mental health, self-perceived image and satisfaction with management as depicted in bar graph.



Bar Graph Showing the Results of Changes in Quality of Life

CONCLUSION

This randomised control study proves the efficacy of conservative treatment of AIS. The results of this study confirm the effectiveness of exercises in combination with brace for postural correction in AIS.

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Appendix

Self-correction exercises for AIS:

1. Spinal extension (upper and lower) exercises- 10 times for 5 mins. each.
2. Spinal strengthening of convex side muscles by lying on concave side and upper trunk raising up- 10 times for 5 mins.
3. Active self-correction.
 - Lying on convex side with towel roll placed under apex- 10 mins.
 - Side shift on medicine ball toward convexity- 10 times for 5 mins.
 - Hip hitch exercise- 10 times for 5 mins.

Breathing exercises

- Chest expansion exercises with emphasis on concave side- 5 mins.
- Diaphragmatic breathing exercises- 5 mins.

REFERENCES

1. Stokes IAF: Die Biomechanik des Rumpfes. In: Weiss HR, ed. Wirbelsäulendeformitäten -Konservatives Management. München, Pflaum 2003:59-77.
2. Cobb JR. Outline for the study of scoliosis. In: Edwards JW, Arbor A, eds. AAOS, instructional course lectures. Vol 5. The American Academy of Orthopedic Surgeons 1948:261-275.
3. <http://www.scoliosisjournal.com/content/1/1/5>
4. <http://www.srs.org>
5. Miller NH. The role of genetic factors in the etiology of idiopathic scoliosis. Spine: State of the Art Reviews 2000;14:313-317.
6. Monticone M, Ambrosini E, Cazzaniga D, et al. Active self-correction and task-oriented exercises reduce spinal deformity and improve quality of life in subjects with mild adolescent idiopathic scoliosis. Results of a randomised controlled trial. Eur Spine J 2014;23(6):1204-1214.
7. Landauer F, Wimmer C. Therapieziel der Korsettbehandlung bei idiopathischer Adolozentenskoliose. MOT 2003;123:33-37.
8. Hayes RJ, Bennet S. Simple sample size calculation for cluster-randomized trials. Int J Epidemiol 1999;28(2):319-326.
9. Lenssinck ML, Frijlink AC, Berger MY, et al. Effect of bracing and other conservative interventions in the treatment of idiopathic scoliosis in adolescents: a systematic review of clinical trials. Phys Ther 2005;85(12):1329-1339.
10. Mordecai SC, Dabke HV. Efficacy of exercise therapy for the treatment of adolescent idiopathic scoliosis: a review of the literature. Eur Spine J 2012;21(3):382-389.
11. Neigrini S, Antonini G, Carabalona R, et al. Physical exercises as a treatment for adolescent idiopathic scoliosis. A systematic review. Pediatr Rehabil 2003;6(3-4):227-235.
12. Negrini S, Fusco C, Minozzi S, et al. Exercises reduce the progression rate of adolescent idiopathic scoliosis: results of a comprehensive systematic review of the literature. Disabil Rehabil 2008;30(10):772-785.
13. Weiss HR, Goodall D. The treatment of adolescent idiopathic scoliosis (AIS) according to present evidence. A systematic review. Eur J Phys Rehabil Med 2008;44(2):177-193.
14. Dolan LA, Weinstein SL. Surgical rates after observation and bracing for adolescent idiopathic scoliosis: an evidence-based review. Spine (Phila Pa 1976) 2007;32(19 Suppl):S91-S100.
15. Dolan LA, Weinstein SL. Best treatment for adolescent idiopathic scoliosis: what do current reviews tell us? In: Wright JG, ed. Evidence-based orthopedics: the best answers to clinical questions. Philadelphia: Saunders 2009.
16. Focarile FA, Bonaldi A, Giarolo MA, et al. Effectiveness of nonsurgical treatment for idiopathic scoliosis: overview of available evidence. Spine (Phila Pa 1976) 1991;16(4):395-401.
17. Negrini S, Minozzi S, Bettany-Saltikov J, et al. Braces for idiopathic scoliosis in adolescents. Cochrane Database Syst Rev 2010;1:CD006850.
18. Screening for idiopathic scoliosis in adolescents. Rockville, MD: Preventive Services Task Force 2004. <http://www.uspreventiveservicestaskforce.org/uspstf/uspaisc.htm>.
19. Nachemson AL, Peterson LE. Effectiveness of treatment with a brace in girls who have adolescent idiopathic scoliosis. A prospective, controlled study based on data from the brace study of the scoliosis research society. J Bone Joint Surg Am 1995;77(6):815-822.
20. Weinstein SL, Dolan LA, Wright JG, et al. Effects of bracing in adolescents with idiopathic scoliosis. N Eng J Med 2013;369(16):1512-1521.
21. Asher MA, Burton DC. Adolescent idiopathic scoliosis: natural history and long term treatment effects. Scoliosis 2006;1:2.
22. Rowe DE, Bernstein SM, Riddick MF, et al. A meta-analysis of the efficacy of non-operative treatments for idiopathic scoliosis. J Bone Joint Surg Am 1997;79(5):664-674.

23. Rigo M, Reiter Ch, Weiss HR. Effect of conservative management on the prevalence of surgery in patients with adolescent idiopathic scoliosis. *Pediatr Rehabil* 2003;6(3-4):209-214.
24. Weiss HR, Weiss G, Schaar HJ. Incidence of surgery in conservatively treated patients with scoliosis. *Pediatr Rehabil* 2003;6(2):111-118.
25. Varni JW, Seid M, Kurtin PS. Peds QL 4.0: reliability and validity of the pediatric quality of life inventory version 4.0 generic core scales in healthy and patient populations. *Med Care* 2001;39(8):800-812.