

Efficacy of Pivotal Response Training in Management of Visual Conceptual Deficits in Adult Autistic Population

Gunjan Kumar¹, Darshpreet Kaur², Nidhi Billore³, Ramesh K. Jeyaraman⁴

¹Assistant Prof., Dept. of Neurology, Patna Medical College & Hospital, Patna, Bihar; ²Chief Physiotherapist, Bihar Neurodiagnostic Centre, Patna, Bihar; ³Ex. Assistant Prof., R.V. College of Physiotherapy, Bangalore, Karnataka, ⁴Prof. & HOD of Physiotherapy, Sri Devaraj Urs Academy of Higher Education & Research, Kolar, Karnataka

Abstract

Background and Objectives: Recent years have witnessed revolutionized increase in number of Autistic individuals. With world-wide prevalence rate ranging from 7-13 cases per 10,000. In India, the occurrence is approximately 1 in 500 people. Among various impairments seen in Autism, visual conceptual deficit is the one which leads to impaired complex information processing and task shifting activities; leading to difficulties in executive functions. The aim of the present study was to examine visual conceptual deficit in these individuals and subsequently give a therapy which aims at reducing this deficit. **METHOD:** 40 adults with Autism, both male and female satisfying the inclusion criteria was included for the study (age 30-50 years). Their visual conceptual deficit was measured using Comprehensive Trail Making Test. Thereafter, they were subjected to Pivotal Response Training for 8 weeks. After 8 weeks of the therapy the effectiveness of Pivotal Response Training was re-evaluated using Comprehensive Trail Making Test. **RESULTS:** The subjects showed an improvement in multitask performance post pivotal response training and also significant improvement in visual conceptualization i.e. visual tracking and visual set shifting tasks. **Conclusion:** The findings in the present study focus a new light on the efficacy of Pivotal Response Training in improvement of visual conceptual deficit in adults with Autism.

Keywords: Autism, Visual conceptual deficit, Comprehensive Trail Making Test, Pivotal Response Training.

Introduction

Autism is a neurally based psychiatric disorder; affecting multiple domains of cognitive, sensorimotor and socio-behavioral function. Not only are autistic individuals emotionally ill, but otherwise normal, they have one of a group of developmental disorders of brain function, which is collectively called Pervasive Developmental Disorders.

DSM-IV-TR and ICD-10, defines Autism on the basis of behavioral features and age of onset. Autistic

traits persist into adulthood, but with wide range of outcomes.

Impairments in Autism: In Autism, there is a triad of impairments in social skills, communication and imaginative activities,⁰¹ the causes of which can be attributed to biological,⁰² prenatal factors like tuberous sclerosis, intrauterine rubella etc., chromosomal abnormalities, postnatal conditions like untreated phenylketonuria, infantile spasms etc.⁰³ familial linkage⁰⁴ Gene linkages like serotonin-transporter gene.⁰⁵ Other impairments seen in Autism are behavioral expression of social deficits, expression of language deficit, expression of impairment in play, cognitive alterations, sensorimotor impairments and epilepsy.⁰⁶

Visual Conceptual Deficit: Autistic individual show selective impairment in complex information processing across domains. They perform poorly on

Corresponding Author:

Dr. Gunjan Kumar

Assistant Prof., Department of Neurology, Patna Medical College & Hospital, Patna
Ph.: 9902307772

meaningless materials, but they are able to utilize meaning to aid their visual memory.⁰⁷

Various therapeutic approaches are available to improve cognitive disability in Autism like Applied Behaviour Analysis⁰⁸, Discrete Trial Teaching⁰⁹, Structured Teaching (TEACCH)¹⁰ Cognitive Behavioural Modification (CBM)¹¹, Cognitive Learning Strategies¹² and PIVOTAL RESPONSE TRAINING (PRT) etc.

Pivotal Response Training has been proved to be effective in various domains like, improving communicative and socio-emotional functioning,¹³ improving complex task performance and creative activities^{14,15} and self-initiation skills¹⁶ in autistic individuals.

Pivotal Response Training: This behavioral treatment is based on principles of ABA and derived from the work of Koegel, Schreibman, Dunlap, Horner and other researchers.¹⁷ Key pivotal behaviors have been identified for individuals with Autism: motivation and responsivity to multiple cues (Koegel and Koegel).

Considering the enormous benefits exhibited by PRT, as highlighted by various researches; this therapeutic approach has been chosen for improving visual conceptual deficits in adult Autistic population.

Methodology

40 adult autistic subjects were selected from the population through convenient sampling method in this experimental study. The subjects were recruited from special care homes in and around Bangalore. The study was done for 8 weeks for 5 days a week with an hour therapy session on each day.

Inclusion Criteria: Subjects diagnosed with Autism according to DSM-IV-TR criteria²¹, Having mild to moderate grade of Autism as diagnosed by Neuropsychiatrist, Subjects between the age group of 30-50 years, both male and female were included in this study.

Exclusion Criteria: Subjects with refractive epilepsy, primary and secondary optic atrophy, Leber Congenital Amourosis, fetal toxic encephalopathy, infectious fetal encephalopathy, autism spectrum disorder, mentally deranged patients, Charles-Bonnet syndrome, adenolyase succinate deficiency, cystosolic^{5'} nucleotidase deficiency, paroxysmal disorders,

phenylketonuria, mucopolysaccharidosis.

Materials Used: A stop watch, Comprehensive Trail Making Test sheets, Pencils, Gardening tools, alphabets and numbers board, jigsaw puzzles, neuropsychiatrist assessment form according to DSM-IV-TR for Autism was used.

Data Collection Procedure: The study got ethical clearance from the institute. These subjects were screened by neuropsychiatrist and included in the study. A sample of 40 subjects was selected from the population by convenient sampling. Subjects and their guardians gave an informed consent before being included in the study. A brief assessment was done for each subject as per the proforma.

Their visual conceptualization was measured with the help of Comprehensive Trail Making Test. Each step of the test was clearly explained to the subjects before its execution and subsequently time taken by subjects to complete each trail was recorded using stop watch. These readings were collected for all the subjects before giving Pivotal Response Training.

Before giving main test sheets, the subjects were made to undertaken Sample Tests: In Sample A²², the subjects were made to join numbers 1 through 5 and ignore six distracter circle array, once the subject successfully completed Sample A, Trail 1 to trail 4 were given.

Similarly, before undertaking Trail 4, subjects were made to solve Sample B. It was comprised of 5 circles with Arabic numerals inside them and 3 rectangles with number words printed therein.

After successful completion of trail 4 subjects were administered Sample C, It was consisted of 9 circles with numbers (1-5) or letters (A-D) printed inside them.

In case, the subjects who were not able to complete sample test, further trails were not undertaken and consequently the test was terminated.

In the present study, time taken to complete the test was recorded. Where an error occurred, the participants were directed to correct it but the clock was continuously recording the time duration. Total time taken to finish the task was considered as the final score. Numbers of error were not recorded. Standardized scores were given in the form of T-score, with a mean of 50 and Standard deviation of 10.

On the basis of comprehensive trail making test scores, patients were subjected to pivotal response training. The training included the following steps²³:

- i. The patients were asked to choose any activity of his/her choice from the given choices i.e. gardening tool, alphabet or number board, jigsaw puzzles etc.
- ii. The chosen activity was then varied with a new task, keeping the patient's interest intact.
- iii. These tasks when mastered, were then, interspersed with another task to maintain sense of competence and to increase the likelihood that the subjects may also attempt this task.
- iv. All these mastered tasks were re-enforced among

the patients by demonstrating appropriate social interactions.

- v. All the steps of the intervention were repeated at the end of each session

Pivotal Response Training was given for 8 weeks for 5 hours per week.²⁴ Each session was consisted of an hour therapy session on each day. At the end of 8 weeks, Comprehensive Trail Making Test was repeated.

Results

The data was put for analysis using SPSS 11.0 software, to compare the pre and post therapy test scores, to find out the significance of the data.

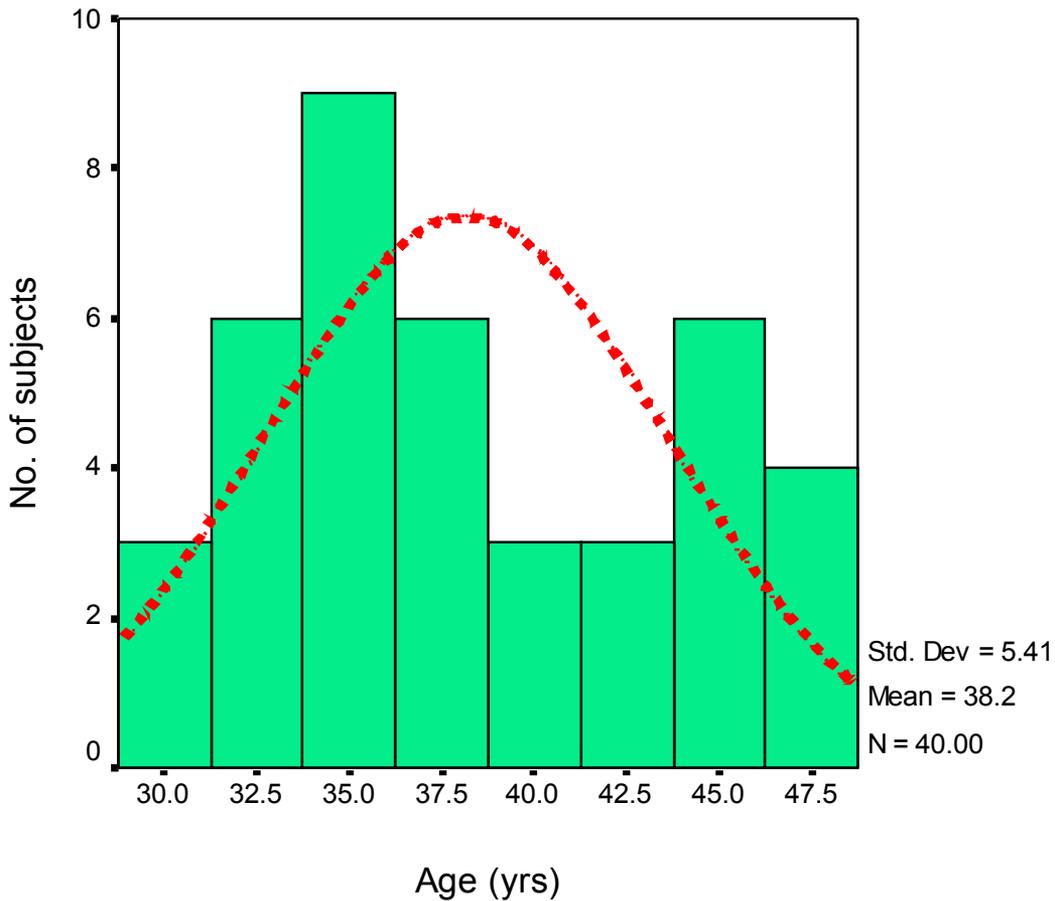


Figure 1: Distribution of age in various age groups

In the present study it is observed that 2 (5.0%) of the subjects are ≤ 30 years, 11 (27.5%) of them are in the age group of 31-35 years, 14 (35.0%) belonged to 36-40

years of age, 9 (22.5%) are in 41-45 years of age group and 4 (10.0%) between 46-50 years. The mean age is 38.2 years with a standard deviation of 5.41 years.

Table 1: Pre and post therapy scores

	Pre therapy		Post therapy		Effect size	t-value	P-value
	Mean	SD	Mean	SD			
Part1	119.35	26.36	100.65	24.89	1.03	23.565	<0.001
Part2	107.78	27.16	89.93	25.66	0.96	21.383	<0.001
Part3	143.93	13.70	123.88	14.94	1.98	22.382	<0.001
Part 4	132.93	22.99	113.05	21.86	1.25	25.572	<0.001
Trail B	191.93	30.27	171.68	29.35	0.96	20.586	<0.001
Total time (seconds)	695.92	120.48	599.19	116.70	1.24	22.697	<0.001

The total time has an overall effect size of 1.24 with Mean±SD of 695.92±75.30 and 599.19±72.17. The overall percentage reduction is observed to be 13.39 which is found to be statistically significant (P<0.001).

Table 2: Comparison of pre and post test score improvement among various age groups

Age (Year)	No. of subjects	Pre-therapy	Post-therapy
		Mean	Mean
≤30	2	51.87	48.52
31-35	11	52.49	51.09
36-40	14	52.01	52.03
41-45	9	48.11	48.74
46-50	4	39.36	40.07
Total	40	48.77	48.09

Variables in this table show more improvement in visual conceptual deficit in younger age groups (30-35 years) as compared to older age groups (35-50 years).

Table 3: Comparison of Trail B mean scores pre and post therapy.

Total Time (Seconds)	Pre-therapy	Post-therapy
	Mean	Mean
≤500	-	125.50
501-550	130.00	149.63
551-600	165.00	173.19
601-650	173.44	177.60
651-700	184.50	179.00
701-750	227.00	200.00
751-800	189.50	223.00
>801	225.60	-
Total (Average)	161.88	153.49

Discussion

In the present study, an attempt was made to examine the influence of Pivotal Response Training over visual

conceptual deficit in adult autistic population. The results have shown that there is a significant reduction in visual conceptual deficit Post-pivotal Response Training.

Determining visual conceptual deficit involves a set of visual set shifting and visual tracking tasks which can be conducted through many tests like Rey- Osterreth Complex Figure Test and Recognition Trial, Wisconsin card Scoring Test-Revised and Expanded etc., but Comprehensive Trail Making Test which is derived from Halstead-Reitan Neuropsychological Test Battery, is a brief test to assess visual scanning, graphomotor speed, cognitive flexibility, temporal sequencing and planning.²⁵

Neurological Basis of Autism: Anatomical abnormalities have been identified in many brain areas in Autism. These include the cerebellum²⁶, the brain stem, frontal lobes²⁷, Parietal lobes, hippocampus²⁸ and the amygdale.

Purkinje cells being abnormally low in the cerebellar cortex is abnormally low, leads to a disinhibition of the cerebellar deep nuclei and consequently over-excitement of the thalamus and cerebral cortex.²⁹

Hyper arousal in response to sensory input and decreased ability to select between competing sensory inputs has been reported. fMRI studies have shown increased activity in sensory areas of the brain causing stimulus driven processing and decreased activity in areas normally associated with higher cognitive processing.²⁹ Both the hemispheres show abnormal activation indiscriminately during shifts of attention into any hemifield. There’s also a deficit in rapid shifting of attention between modalities, between spatial locations and between object features.

MRI morphometry shows volume deficits in cerebellum, brainstem, posterior corpus callosum

and parietal lobe. PET & Single Photon emission CT, showed abnormalities in metabolism or regional blood flow in temporal lobe and cerebellum.

Thus autistic individuals show significantly greater cerebellar motor activation and significantly less cerebellar attention activation.

Causes of Visual Conceptual Deficit in Autism:

Some high-functioning individuals with Autism display repetitive stereotyped behaviors, perseveration and obsessionality.

Autistic individuals have selective impairment in complex information processing across domains. Autistic subjects perform poorly on meaningless materials, while using visual recognition memory task, but they are able to utilize meaning to aid their visual memory⁰⁷.

People with Autism act differently because they think differently:

- They have an enhanced awareness of details.
- They have reduced understanding of meaning & reduced capacity for conceptual reasoning in all areas.
- They can only handle small amounts of new information.
- They may use different cognitive skills to compensate.
- If the information or task is visual, they are able to understand more.

These differences are due to differently wired brain in Autistic individuals. Thus neuro developmental delay in Autism may particularly impact on the Left hemisphere and consequently explain some of the developmental Executive function anomalies found in this disorder.¹⁸

Autistic people use more non-verbal visually oriented processing and rely on visuospatial analysis, thereby resulting in more activation in posterior regions than anterior, associated with visual processing and more activation in right than left hemisphere.

Comprehensive Trail Making Test can effectively measure these deficits through a set of trail making tasks. This test is extremely sensitive to neurological insult, disease, injury or dysfunction¹⁹. It takes 5-12 minutes to administer and less than 5 minutes to score. This test is designed to enhance the frontal lobe components of

the task by introducing inhibition on several trials and impairments in set shifting.

Pivotal Response Training is one of the latest therapeutic approach that can be used for improvement of social, emotional and behavioral outcomes in Autistic people. This therapy is given in natural environment of an individual. This optimizes communicative and socio-emotional functioning¹³. This therapy helps an individual to learn to perform complex and creative activities²⁰. PRT can also improve self-initiating skills.

PRT, thus, aims at improving MIRROR NEURONS, which show significantly less activity in Autism. These neurons are responsible to help in visual cues. These are particular type of brain cells that have the unique property of firing both when an individual performs a goal directed action as well as when he/she observes the same action performed by others.

Limitations of this study: In the present study educational status of the individuals and their knowledge in English language was not evaluated. The Comprehensive Trail Making Test can give variable result in individuals with fluency in English and also with higher Intelligent Quotient. The long term effects of this therapy were not calculated and the study was conducted on a very small population.

Physiotherapy Implications: The current study has opened doors for physiotherapists to explore the role of a therapist in executive function disorders. PRT is a new therapy in field of physiotherapy but if learnt and practiced it can prove to be a real boon in this field. Even Comprehensive Trail Making Test can be used in other neurological disorders like post Stroke, Traumatic head injury etc. on the basis of the result, a physiotherapist apart from the usual therapy can take care of their higher mental functions too effectively.

Ethical Clearance: Taken from Krupanidhi College of Physiotherapy & RGUHS, Blr ethical committee.

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Conflict of Interest: Nil

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