ARTICLE

Development and Validation of a Questionnaire to Assess Parent Reported Quality of Life Pre and Post Vision Therapy in a Population with Autism Spectrum Disorder

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ABSTRACT

Background

Autism spectrum disorder is characterized in part by atypical behavior in the communication, social, and visual domains. Success in vision therapy is judged not only by changes in optometric findings, but through improvement in quality of life involving communication, social behavior and visual behavior. It would therefore be beneficial to have a validated questionnaire to assess parent reported quality of life pre and post vision therapy specific to patients with autism spectrum disorder. To our knowledge, a questionnaire of this nature has not been previously published in the literature.

Methods

Questionnaire items were generated through surveying medical literature based on symptoms in three different categories: visual behavior, social behavior and communication. A pool of 34 questions was developed initially and then with thorough discussion with other experts, a 20-point questionnaire was developed with each item reflected in the construct concept. A draft of 20 questions was then sent to 10 subject experts with clinical experience in the field for more than 20 years, to review the pooled items. Validity and reliability was established prior to assessing the psychometric properties of the ASD/QOL-VT.

Prospective observational study was conducted for a duration of 18 months. The study included individuals undergoing vision therapy in the age range of 3 to 15 years who had been diagnosed with ASD. The questionnaire was administered to parents of these children prior to the start of vision therapy. All subjects completed a minimum of 60 vision therapy sessions. The questionnaire was re-administered after completing 60 sessions of vision therapy.

Results

Cronbach's alpha value for this questionnaire was 0.93, which reflected very good internal consistency. Factorial analysis yielded four factors with an Eigen value exceeding 1.0 which accounted for 68% variation in the model. The Cronbach alpha value for subscales identified by factorial analysis is 0.97 indicating excellent internal reliability. The mean pre vision therapy social behavior, communication

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and visual behavior score was 12.0±3.21, 17.07±4.57 and 26.97±6.41 respectively. The mean post vision therapy scores for social behavior, communication and visual behavior was 8.27±4.16, 11.33±5.27 and 17.93±6.52 respectively. On paired t test, the mean difference in score was statistically significant with P<0.001 in all three subcategories.

Conclusions

Our study presents the development of a valid and reliable parent questionnaire, the ASD/QOL-VT, that judges communication, social behavior, and visual behavior in autism. Results of the study conducted indicate that vision therapy can result in significant improvements in the quality of life of patients with ASD as judged by their parents. This is evidenced by statistically significant changes in psychometric properties of the ASD/QOL-VT in social behavior, communication and visual behavior.

INTRODUCTION

Autism spectrum disorder is characterized by severe deficits in socialization, communication, and repetitive or unusual behaviors. Autism is a neurodevelopmental disorder in the category of pervasive developmental disorder.[1] According to the DSM-5 criteria for autism diagnosis adopted in May 2013, autism spectrum disorder involves "persistent impairment in reciprocal social communication and social interaction, and restricted, repetitive patterns of behavior, interests, or activities present from early childhood and limit or impair everyday functioning." In the DSM-IV diagnostic criteria, there are 5 subgroups of pervasive developmental disorders included Autistic disorder, Asperger's syndrome, Rett's disorder, child disintegrative disorder (CDD), and pervasive developmental disorder- not otherwise specified (PDD-NOS). In the DSM-5 Rett's disorder is excluded from the criteria and considered as a separate diagnosis. Autism spectrum disorder therefore encompasses Autism, Asperger's Syndrome, Child Disintegrative Disorder, and PDD-NOS.[2] The global prevalence of ASD is 0.62%, i.e. 62 per 10,000 population, and is reported to occur more among males than females by a ratio of 4.3:1.[3,4]

Autism typically appears during the first three years of life. It affects normal functioning of the brain, and has an impact on the development of social interaction and communication skills. Its exact cause remains unknown, with multiple factors including organic, environmental and genetic causes having been implicated.[5] As reviewed by Maino et al, etiologies of autism spectrum disorder have been reported to include yeast infection, food intolerance, leaky gut syndrome, diets with gluten, seizures and epilepsy, brain injury at the time of birth, vaccines, and genetics.[6]

Rationale for Visual Intervention in Autism

"Vision is a dynamic interactive process of motor and sensory functions, mediated by the eyes for the purpose of simultaneous organization of posture, movement and spatial orientation, for manipulation of the environment and, to its highest degree, of perception and thought." – William V. Padula

Our understanding of vision is that it is a learned process which requires dynamic, efficient and automatic motor components to derive meaning and direct action. Sensory and motor information provides meaning to vision, whereas action is the overt response to the sensory stimulus. Motor activities are necessary to build up visual skills that lead to the development of automaticity and reduce overall stress for the individual.

The vestibular and oculomotor subsystems maintain body posture and stabilize foveal fixation on the target when an individual's head or body is displaced. Any vestibular dysfunction results in postural imbalance and ocular motility disorder. Primitive protective reflexes provide the mechanism through which infants learn to analyze and understand what is being seen. Primitive reflexes help to coordinate the

fine movements of eye muscles, gain accurate accommodative abilities, and develop fusion, fixation and convergence. If primitive reflexes are retained in the body system beyond the maturation periods, they can hinder the normal development of postural reflexes and eye movements.[7]

Development of the visual system is therefore guided by the early presence of primitive reflexes with their subsequent integration. Lack of integration of the various primitive reflexes can have the following consequences:

- **Moro reflex (MR) –** if it remains active for too long the child can be more sensitive to bright light, sound, movement or any alteration in the visual field.
- **Tonic labyrinthine reflex (TLR) –** a retained TLR may affect the development of postural reflex, balance, poor visual information processing and cause difficulty with spatial judgments.
- **Asymmetric tonic neck reflex (ATNR) –** a retained ATNR may affect development and function in establishing hand, leg, eye preferences or body dominances. Problems with ocular dominance can affect reading, writing and spelling.
- **Symmetric tonic neck reflex (STNR) –** a retained STNR can affect the proper development of upper and lower body coordination, cross pattern movements and poor eye hand coordination.

In addition to the sequelae above, Gonzalez and colleagues[7] suggest that there is reduced saccadic accuracy associated with some retained primitive reflexes. Therefore, integrating primitive reflex therapies along with routine vision therapy procedures plays an important role in the overall treatment plan and positive outcome for patients on the autistic spectrum.

Treating ocular motility disorder in autistic children may require providing support for deficiencies in gross motor ability in conjunction with modified techniques that reflect their developmental level. A stabilized body provides the framework for accurate visual motor learning.[8]

As body awareness improves and stability is solidified, the patient discovers that there is a center to his body which constitutes midline. From the center the eyes visually project out into space as he begins to understand and localize himself within the environment. The visual system can then begin guiding body movements. Without centering of the body, motor guidance is difficult, resulting in excessive head and body movement. Therefore, including gross motor, body movements and balance coordination therapies to integrate body midline with visual midline become very important when performing vision therapy.

Incorporating yoked prism to train visual-motor integration can be a powerful tool in vision therapy, particularly when the patient has difficulty in communicating responses verbally. Yoked prism when used for therapy in higher amounts initially creates a mismatch between the visual and vestibular-proprioceptive pathways. When the patient is able to accomplish the activity with altered sensory input provided by the yoked prism, more refined, flexible, and adaptive motor control is exhibited. Yoked prisms may also help to improve posture, walking and balance when used in various different base directions.

The use of low plus lenses may help in expanding visual space volume and emphasizing the figure against the background. This can serve as an aid to improving attention, focus and speed to near visual tasks. The utility of binasal occlusion has also been demonstrated in studies, as evidenced through improved binocularity and enhanced peripheral awareness.[1,9]

Background of the ASD-QOL/VT Questionnaire

The questionnaire used in this study is based on observations regarding the social behavior,

visual behavior, and communication abilities of children on the autistic spectrum as judged by their parents. Here we provide the rationale for selecting these three categories.

Social Behavior

People with autism often have difficulty establishing and maintaining relationships.[2,9]

They do not respond to many of the non-verbal forms of communication that many of us take for granted like facial expressions, physical gestures and eye contact. They are often unable to understand and express their needs just as they are unable to interpret and understand the needs of others. This impairs their ability to share interests and activities with other people. For this reason, they may appear distant and aloof. Because they are often delayed in their speech and struggle to make sense of other non-verbal forms of communication, they may withdraw into repetitive play and behavior and avoid interaction.[4] The ability to process human faces including emotional expression is important for normal child development and is linked to the development of social behavior. Face processing develops very early in life for neurotypical children, typically occurring during the first year. The ability to process faces is experience dependent and requires intact function of the right hemisphere. In behavioral and neuroimaging studies, individuals with ASD have been shown to differ in their processing of faces and emotional expressions.

Analysis of visual scan paths of adult autistic individuals has revealed that they may view the core areas of the face for displaying emotional expression (eyes, nose and mouth) less frequently than they view other areas of the face. In making judgments of the emotional state of another person's face, individuals who have ASD are less likely to use information gathered from the eye region and more likely to use information gathered from the mouth. Individuals with ASD require more time to process pictures of facial expressions than to process pictures of objects.

This impairment in face processing is thought to be the combined result of innate central nervous system irregularities and the subsequent decreased opportunity to decipher faces. Research studies suggest that differences in face processing abilities in autistic individuals are caused by brain-based deficits in visual perceptual processing rather than caused by social deficits.

Another difference in ASD individuals that impacts their ability to function socially are differences in gaze shifts. Babies typically react to a shift in gaze that their caretaker makes to note a new target of interest. For example, if the caretaker is looking for a bottle and looks from the refrigerator to the kitchen table, normally developing babies follow this change in the direction of looking to determine what is happening. By age three months, infants respond differently to objects based upon how a viewed caretaker reacts to an object through the adult's emotional facial expression. Awareness of gaze shift is an important precursor for shared or joint attention between the caretaker and child and serves as a basis for social and emotional development. Individuals with autism make significantly fewer shifts in gaze by age 14 months. Those with ASD also have difficulty linking another person's eye gaze with intent, means they cannot use the cue of where another person is looking as an indicator of where the other person's interest is directed.

As with understanding facial expressions, recognizing faces and gaze shifts are considered as important social behavior markers, and individuals with autism spectrum disorder can benefit largely by vision therapy as it plays an important role in treating the problems related to eye movement abilities, fixation and visual information processing and can greatly enhance the quality of life in ASD.

To summarize, difficulties with social interaction can manifest in the following ways:

- Limited use and understanding of non-verbal communication such as eye gaze, facial expression and gesture
- Difficulties forming and sustaining friendships
- Lack of seeking to share enjoyment, interests and activities with other people
- Difficulties with social and emotional responsiveness

Visual Behavior

Visual behavior for individuals with ASD includes photosensitivity, hyper and hypo sensitivity, anomalous color perception processing, and difference in processing central and peripheral stimuli. Face processing, gaze shifts, visual integration with the other senses, and visual closure are affected as well. It has been also noted that motion processing, visual spatial and visual-motor processing and spatial awareness including visual neglect are anomalous. There are many other visual behaviors associated with ASD, such as looking at an object while tilting head and looking through the corner of the eyes, repetitious movements of the fingers and hands, often within the line of the subject's vision, stereotypical behavior such as fixating on windows and blinds. Poor eye contact, fidgeting with objects, and looking at spinning objects are also some common symptoms and behavior in ASD.

Gaze aversion is a visual behavior frequently associated with ASD in which the individual looks away or avoids eye contact. Poor eye tracking and fixation skills are the most common reasons that contributes to this particular behavior.

Lateral vision or looking through the corner of the eyes has been attributed to faulty binocular processing and poor inter-hemispheric integration.

Hand flapping or flicking fingers near the face is explained as the compensation for poor visual spatial skills as the individual with ASD lacks the awareness of their body parts. As a result, they compensate by seeking additional sensory input to tell them where they are in space.[10]

Vision therapy plays a very important and integral role while treating these visual behaviors in a structured and phasic manner. Observed visual behaviors are directed principally toward the following sub components:

1. **Gross Motor and Spatial Orientation**

   Gross motor control includes bilateral coordination, visual motor integration and body awareness. Bilateral coordination allows the child to differentiate right from left and to gain an inherent knowledge of midline and laterality. Visual motor integration enables the child to transition from motor to vision as the primary learning modality. The child must also be aware of where their body is in space before they can accurately localize targets. These gross motor elements are critical for the development of fine motor control and eye movements.[11]

   Orientation can be viewed as eye-body control, which is essential to knowing where we are in relation to other people and to our surroundings. Management of orientation is vital for success since it enables us to sit still, stay on task, and direct concentration. The eye-body connection is so intimate that any extraneous eye movement interferes with perception. Individuals with visual orientation difficulty have trouble sitting still, concentrating, and staying on task with reading and writing. Other observed behaviors are distractibility and difficulty staying on task. Often this is seen as unwanted movements in motor overflow including excessive talking, wiggling, hand, foot or body movements.

2. **Eye Movements – Fixation, Saccades and Pursuits**

   The eye movement skill of tracking and locating includes the eye control abilities

of fixation, saccades, and pursuits. These include our ability to visually look at and sustain fixation of a target, capability to follow a moving target (pursuits), and the skill to shift one's center of focus between successive points of fixation (saccades).

3. **Focusing Ability – Accommodation**
   Focusing involves adjusting the focus of our eyes (accommodation) for different distances so that we can see clearly and meet our attention needs. Focusing skills require both of the following: 1) an adequate range or ability to shift focusing for both far and nearby seeing, and 2) good flexibility to make shifts quickly, easily, and automatically. Accommodative range and flexibility are required to discern what we select, look at, and perceive.

   There are two complementary requirements for accommodation. One requirement is to be able to shift visual attention and focus quickly, easily and accurately for any needed work or school task distance. The second demand is the ability to sustain focusing for one distance – in one place – over time and still makes small eye shifts as required for reading or attending to necessary details.

4. **Eye Teaming Ability – Binocularity**
   Eye teaming is the ability to yoke and align the eyes precisely so that the brain can unify the input it receives from each eye. Binocular problems encompass difficulty in coordinating and using both eyes together effectively.

5. **Visual Attention and Span**
   Visual Attention and Span refers to how much an individual can visually take in, attend to, and gain understanding at any one time.[12]

6. **Visual Information Processing – Visual Perception**
   Visual information processing can best be described as the developed process of correlating and relating to things, people, and the world around us. Visual unification occurs as one utilizes past experience and correlates information from all areas of vision with inputs from other sensory systems. This overseeing operation of vision embraces many functions often classified as visual perception.[13]

Communication

People with autism often have communication difficulties in one form or another. There are some people with autism who speak fluently, others who are speech impaired to varying degrees and others still, who are unable to speak at all. Among those who can speak readily, language may be used in a very limited or unusual way.

Lines of conversation in ASD may involve repeating phrases or words, or asking the same questions repeatedly. People with autism tend to talk only about topics that are of interest to them, which makes the give and take in communication difficult. They have difficulty interpreting non-verbal forms of communication like facial expressions, hand gestures and other body language.[4]

Impaired communication is characterized by:

- Delayed language development
- Difficulties initiating and sustaining conversations
- Stereotyped and repetitive use of language such as repeating phrases from television

Lack of eye contact, ill sustained fixation and gaze aversions may create obstacles for an individual with ASD in understanding the process of imitation. This serves as a foundation for lip reading and producing sounds in early childhood. Deficiences in these skills may result in delayed speech and poor acquisition of language and communication.

Early intervention through vision therapy may thereby speed up the process of speech and language development.

MATERIALS AND METHODS

Development and Validation of the ASD/QOL-VT Questionnaire

Questionnaire items were generated through surveying medical literature based on symptoms in three different categories: visual behavior, social behavior and communication. A pool of 34 questions was developed initially and then with thorough discussion with other experts, a 20-point questionnaire was developed with each item reflected in the construct concept. A draft of 20 questions was then sent to 10 subject experts with clinical experience in the field for more than 20 years, to review the pooled items. We first established validity and reliability before assessing the psychometric properties of the ASD/QOL-VT.

Establishing Validity

- **Apparent validation:** This was accomplished in consultation with subject experts and guide and subjects.
- **Content validation:** To check items in the questionnaire are representative of the entire theoretical construct the questionnaire is designed to assess. Questionnaire was sent to the panel of 10 subject experts to check whether the items are adequately measuring the construct intended to assess. Once content validation was established, face validation was undertaken.
- **Face validation:** A concept that related to content validity, this refers to the degree to which respondents or the laypersons judge the questionnaire items to be valid.
- After 5 parents completed the questionnaire for the pilot study, they were provided an opportunity to add or remove any question.
- All participants indicated no significant revision required

Establishing Reliability

- Internal consistency or Reliability Coefficient reflects the extent to which the questionnaire items are correlated or whether they are consistent in measurement of the same construct. Internal consistency is commonly estimated using the coefficient alpha also known as Cronbach's alpha.[14-16] Cronbach's alpha ranges from 0 to 1, where 0 is indicates no internal consistency and 1 indicates perfect internal consistency (i.e. all the items are perfectly correlated with one another). For this questionnaire the **Cronbach's alpha value = 0.93 (> 0.70)** which reflected a very good internal consistency.

Assessment of Psychometric Properties of the ASD/QOL-VT

Exploratory Factoral analysis: Principal axis factorial analysis was performed for the items in ASD/QOL-VT with the orthogonal varimax rotation to evaluate the dimensionality of the new instrument.

- Factorial analysis yielded 4 factors with an Eigen value exceeding 1.0 which accounted for 68% variation in the model (it should be above 60%).
- Reliability: Cronbach α value calculated for total scale is 0.93 and for subscales identified by factorial analysis is 0.97 which can be accepted as excellent internal reliability.

The Validated Questionnaire (See Appendix 1)

After the construction of the questionnaire, a prospective observational study was conducted at Caring Vision Therapy and Neuro Vision Rehabilitation Centre in Chennai (India) for a duration of 18 months. The study included individuals undergoing vision therapy in the age range of 3 to 15 years who had

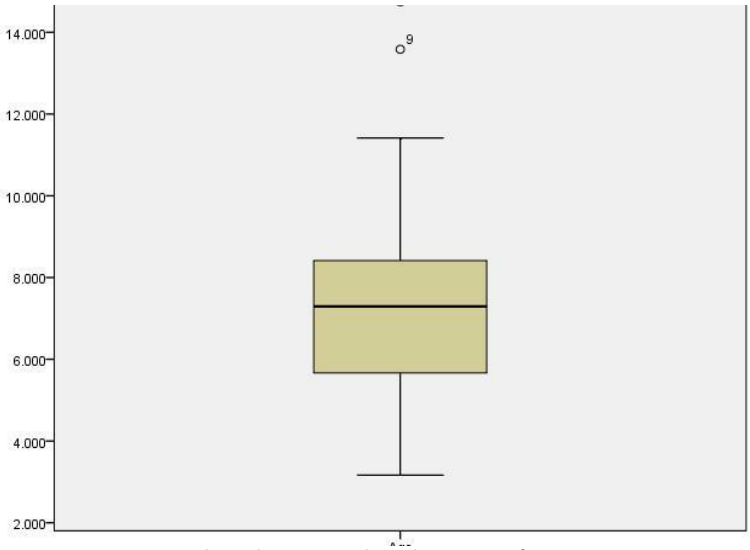

Figure 1: Boxplot showing distribution of age

been diagnosed with ASD. The questionnaire was administered to parents of these children prior to the start of vision therapy. All subjects completed a minimum of 60 vision therapy sessions. The questionnaire was re-administered after completing 60 sessions of vision therapy.

Vision Therapy Procedures (See Appendix 2)

When the eligible subject was enrolled in the vision therapy program, the attending optometrist explained the survey and obtained consent. At the first therapy visit, the questionnaire (Appendix 1) was completed by the parent before any vision therapy was done. The same questionnaire re-administered following 60 sessions of vision therapy. Parents were asked to complete the survey as honestly as possible. The parent's responses from the surveys were compared to evaluate the changes for quality of life pre and post vision therapy. The study excluded any patients who had undergone vision therapy elsewhere within the last year. All the data were entered and analysis was done using SPSS version 21. Paired-t test was used for comparison of pre and post VT questionnaire. P-values less than 0.05 were considered statistically significant.

Table 1. ASD/QOL-VT Subcategory Findings

	Pre	Post	
	Mean ± SD	**Mean ± SD**	**P-Value**
Social Behavior	12.0 ± 3.21	8.27 ± 4.16	<0.001
Communication	17.07 ± 4.57	11.33 ± 5.27	<0.001
Visual Behavior	26.97 ± 6.41	17.93 ± 6.52	<0.001

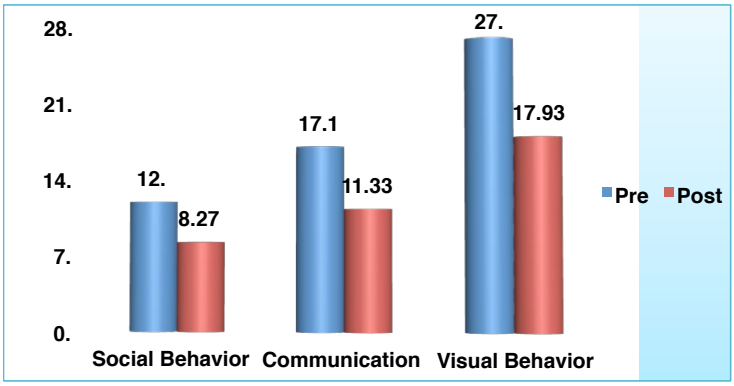

Figure 2: Bar diagram showing the mean pre and post VT subcategory scores

RESULTS

A total of 30 subjects who completed at least 60 session of vision therapy was included in the study. Of these 77% (n=23) were males and 23% (n=7) were females. The mean age of subjects in the study was 7.43±2.82 years (3 years 2 months – 14 years 9 months).

The pre and post scores of the three sub group of the questionnaire, i.e. social behavior, communication and visual behavior were analyzed using paired t-test. The mean pre vision therapy social behavior, communication and visual behavior scores were 12.0±3.21, 17.07±4.57 and 26.97±6.41 respectively. The mean post vision therapy scores for social behavior, communication and visual behavior were 8.27±4.16, 11.33±5.27 and 17.93±6.52 respectively. On paired t test, the mean difference in score was statistically significant with P<0.001 in all three subcategories.

DISCUSSION

We developed and validated the autism specific quality of life questionnaire (ASD/QOL-VT) as a new parent administered measure for judging quality of life changes in autism spectrum disorder. On the basis of psychometric testing, the ASD/QOL-VT was judged to be reliable and valid as a questionnaire to probe changes pre and post vision therapy.

Regarding reliability, good to excellent internal consistency and reproducibility were observed in all sub-groups.

To our knowledge, this is the first validated questionnaire addressing various components of autism that may be impacted by vision therapy. The ASD/QOL-VT can therefore assess the impact that vision therapy is having on the quality of life of these children as judged by their parents. It is very important when treating these disorders that the patient's condition, including changes in QOL be monitored longitudinally. The ASD/QOL-VT may help clinicians understand the severity of the disorder and detect changes caused by interventions, as well as allow them to compare efficacy between the interventions.

Motor impairments in ASD manifest as both delays and deficits, with delays found in the gross and fine motor domains and deficits found in praxis, coordination and gait.[17] There is significant diversity in the diagnostic processes for ASD as seen in the literature. Some publications rely on criteria mentioned in the DSM while others use classifications as specified in ICD-10. Some reports rely on diagnosis by clinical specialists, while others base their diagnosis on parental communication or past history of ASD designation. Diagnosing ASD has therefore historically been less of a definitive process and more of a diagnosis through a set of criteria based on behavioral observations. These behaviors are typically confirmed through formal interview, administration of questionnaires, and observation of the child. Currently the Autism Diagnostic Observation Schedule (ADOS) and Autism Diagnostic Interview – Revised (ADI-R) are considered to be the gold standard regarding patient history in the diagnostic evaluation for autism spectrum disorder.

Functional vision abnormalities are one of the main characteristics affecting the ASD population. A study done by Neupane et al found that 66% of children diagnosed as having ASD had visual abnormalities.[5]

Within the general population, vision therapy has been shown to improve control of eye movements during reading.[18,19] Recent studies have provided additional evidence for the treatment of other visual dysfunctions such as convergence insufficiency and accommodative dysfunctions through vision therapy.[20,21] To date, however, there are relatively few reports on the efficacy of vision therapy for special needs populations. In a series of studies, Kaplan and colleagues noted remarkably improved posture, body orientation, and visual motor task performance in autistic children when employing yoked prism.[22,23]

The question of whether or not vision therapy improves a patient's quality of life has been addressed in studies of the general population done by Cook[24] and Harris & Gormley.[25] Both studies highlighted the significant impact that vision therapy can have on the quality of life in patients suffering from visual abnormalities. However, as Harris and Gormley concluded, it would be beneficial to examine changes in quality of life assessments for specific diagnoses, such as autism spectrum. There remains scant literature providing evidence for the success of vision therapy in ASD based on quality of life changes. Though these patients may never reach age equivalent levels of proficiency, improvement is possible and may contribute greatly to their quality of life and daily activities.

The results of the present study indicate that vision therapy can result in significant improvements in the quality of life of patients with ASD as judged by their parents. This is evidenced by statistically significant changes in the ASD/QOL-VT in social behavior, communication and visual behavior. A decrease in the score on the questionnaire is attributable to improvements in the quality of life. Changes in the visual behavior sub-category, where the mean pre vision therapy score of 26.97±6.41 improved to to 17.93±6.52 post therapy, bolster the impact of vision therapy on ASD populations beyond traditional clinical measures.

CONCLUSION

As visual behavior is an important aspect of Autism Spectrum Disorder, this study shows improved outcome and reduction of overall symptom scores post vision therapy, along with improvement in social behavior and communication. This validated ASD/QOL-VT questionnaire can serve as a new and useful instrument for measuring and improving quality of life in Autism Spectrum Disorder.

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Appendix 1

ASD/QOL-VT

Social behaviour (Functioning problem with)	Never a Problem	Almost a Problem	Sometimes a Problem	Often a Problem	Always a Problem
i. Your child getting along with other children	0	1	2	3	4
ii. Your child is able to do the things other children his age can do	0	1	2	3	4
iii. Your child keeps up when playing with other children	0	1	2	3	4
iv. Your child shares enjoyment, interest or achievement with other people	0	1	2	3	4
Communication (Functioning problem with)					
v. Your child responds only by repeated questioning	0	1	2	3	4
vi. Your child in unable to ask appropriate questions	0	1	2	3	4
vii. Your child talks to him or herself	0	1	2	3	4
viii. Your child points to objects but does not name objects	0	1	2	3	4
ix. Your child is unable to understand and follow instructions	0	1	2	3	4
x. Your child is unable to initiate talk	0	1	2	3	4
Visual behaviour (Functioning problem with)					
xi. Your child unable to sit still and sustain concentration with reading and writing tasks	0	1	2	3	4
xii. Your child is easily distracted	0	1	2	3	4
xiii. Your child loses place when looking from board to desk	0	1	2	3	4
xiv. Your child has an attention problem	0	1	2	3	4
xv. Your child has difficulty with eye contact when talking or listening	0	1	2	3	4
xvi. Your child holds reading or writing material very close	0	1	2	3	4
xvii. Your child has excessive blinking or loss of peripheral awareness	0	1	2	3	4
xviii. Your child does not complete given task on proper time	0	1	2	3	4
xix. Your child is unable to correlate or recall information from the past	0	1	2	3	4
xx. Your child stares at spinning objects or lights	0	1	2	3	4

Appendix 2
Vision Therapy Activities

Orientation:

- Balance and motor coordination activitieswith visual fixation targets
  - Body awareness activities
  - Heel to toe rock with hart chart fixation at 1 meter
  - Bean bag basketball – underarm and overarm throwing
  - Commando crawl
  - Letter tracking and bouncing ball
  - Tape walking with yoke prisms
  - Walking beam activities with yoke prisms
  - Trampoline activities with charts
  - Flashlight walk

- Yoked prisms to expand the body balance range while maintaining visual target
  - Angels in snow
  - Jumping jacks
  - Chalkboard circles

- Primitive reflex integration (Once in 2 weeks in office + home therapy)
  - Moro reflex
  - Tonic labyrinthine reflex
  - Spinal gallant reflex
  - Asymmetrical tonic neck reflex
  - Symmetrical tonic neck reflex

EYE MOVEMENTS (SACCADES AND PURSUITS)

- Pursuits
  - Peg board rotator
  - Marsden ball – tracking, tapping and catching
  - Sanet Vision Integrator – Rotator module (1 to 4)
    – Sannet Vision Integrator - rotational charts

- Saccades
  - Sannet Vision Integrator – eye hand and Saccades modules
  - Four corner flash light
  - Four corner saccadic chart
  - Saccadic workbooks by Bernell – home training

Appendix 2
Vision Therapy Activities
(continued)

ACCOMMODATION
- Low plus lenses along with bi-nasal prescribed.
- Loose lens rock and Lens flippers being used with picture charts and Hart charts

EYE TEAMING AND VERGENCE ACTIVITIES
- Brock string
- 50 cm Styrofoam rod marked with fluorescent green marker illuminated under blue light for highlighting the dots to fix the pins at variable distances
- VTS-4 – Manual vergence and Multiple-choice vergence

VISUAL ATTENTION AND SPAN
- Tachistoscope programs on CPT and SVI – visual and auditory
- Visual span – CPT
- Visual concentration – CPT

VISUAL INFORMATION PROCESSING (VISUAL PERCEPTION)
- Laterality and directionality training
- Kirschener arrows
- Parquetry blocks activities
- Computerized visual perception programs in CPT by HTS
- Mellani-Lambert work sheets for home training
- Visual motor coordination bat with colour chart in advance levels for developing visuo-motor coordination
- Tracing games for VMI