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Eye movement tracking in pediatric obsessive compulsive disorder

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ABSTRACT

Till date researchers have elucidated the neurobiological substrates in OCD using methods like neuroimaging. However, a potential biomarker is still elusive. The present study is an attempt to identify a potential biomarker in pediatric OCD using eye tracking. The present study measured pro-saccade and anti-saccade parameters in 36 cases of pediatric OCD and 31 healthy controls. There was no significant difference between cases and controls in the error rate, peak velocity, position gain and latency measures in both pro-saccade and anti-saccade eye tracking tasks. With age, anti-saccades become slower in velocity, faster in response and more accurate irrespective of disorder status of the child. Pro-saccades also show a similar effect that is less prominent than anti-saccades. Gain measures more significantly vary with age in children with OCD than the controls, whereas latency measures positively correlated with age in children with OCD as opposed to being negatively correlated in the controls.

Findings of this study do not support any of the eye tracking measures as putative diagnostic bio-markers in OCD. However, latency and gain parameters across different age groups in anti-saccade tasks need to be explored in future studies.

1. Introduction

Among adolescents between 12–18 years, Obsessive-compulsive disorder (OCD) has a prevalence of 0.8% in Indian population (Jaisoorya et al., 2015; Rosenberg and Keshavan, 1998). In fact, over 80% of OCD patients have an early onset, i.e. in childhood and adolescence (Jaafari et al., 2011; Pauls et al., 1995).

A neurobiological model of OCD strongly implicates ventral prefrontal cortex and striatal circuitry using lesion studies (Rosenberg and Keshavan, 1998). Studies are far less in number in the pediatric population with OCD. Studies exist in plain imaging modalities i.e. CT, MRI with voxel-based morphometry; functional imaging modalities like fMRI, PET, SPECT, proton MRS & Neuropsychological tests (Abramovitch et al., 2012).

OCD is a psychiatric disorder with an incompletely understood complex genetic and environmental basis (Nestadt et al., 2010). For such non-Mendelian disorders, endophenotypes can act as a biomarker of the disorder. Eye-tracking dysfunctions were long been proposed as an endophenotype of psychiatric disorder (Gottesman and Gould, 2003). These dysfunctions were proven to be reliable with high test-retest reliability in both patients and healthy individuals (Reilly et al., 2008).

According to previous studies exploring eye tracking studies in patients with OCD, pro-saccades were essentially equal in cases and controls (Jaafari et al., 2011). Regarding anti-saccade tasks, the earlier studies with adult patients with OCD found more anti-saccade error rate (Tien et al., 1992) but similar latency (Rosenberg et al., 1997a,b) in patients with OCD compared to controls. But, recent studies found no significant difference among anti-saccade error rate. Rather those studies found more latency in OCD patients in the anti-saccade task (Jaafari et al., 2011; Maruff et al., 1999; Van Der Wee et al., 2006)

Oculomotor tasks are simple and can readily be performed successfully by children. These tasks are less likely to be affected by verbal and learning strategies and can be measured with extreme precision. In addition, these tasks are usually rich with desirable parameters (Luna et al., 2008), these are non-invasive and-inexpensive.

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Eye movement control also slowly develops from childhood through adolescence to adulthood (Luna et al., 2008)

Abramovitch et al (2012) in their review also observed that pediatric OCD population has some similarity as well as the significant difference in neurobiological measures from the adult population with OCD. They also suggested that the developmental perspective may be instrumental in such difference in neurobiological measures in pediatric and adult patients with OCD.

Though there are series of eye movement studies in children diagnosed with schizophrenia, Autism Spectrum Disorder and ADHD, only one study till date has included children with OCD (Rosenberg et al., 1997a,b).

An inverse correlation was observed between age and rate of anti-saccadic response suppression error, both in OCD and control. Though slopes are not significantly different, there is a temporal delay in development of skill acquisition in OCD children (Rosenberg et al., 1997a,b). All latencies slowly decrease from childhood to adults (Luna et al., 2008). Response suppression failure in anti-saccade tasks reduces rather steeply with age till adulthood. The accuracy of both initial saccade and final gaze location in oculomotor delayed return also increases from childhood to adulthood. (Luna et al., 2008)

The pediatric OCD study (Rosenberg et al., 1997a,b) was done with instruments that are now outdated for measuring eye movements. The status of eye movement as a biomarker of pediatric OCD needs to be clarified by further studies. Other demographic variables can also have an independent impact on these eye movement parameters either directly or through some yet to be identified confounding variables which can accentuate or mask the effects of OCD on these parameters. In this study we attempted to explore these possibilities also.

2. Materials & methods

2.1. Study design

This is a study with a case-control design. Institutional Ethics Committee of NIMHANS, Bangalore approved the study prior to its initiation. Cases were recruited from out-patient and in-patient settings of department of child and adolescent psychiatry as well as once a week OCD clinic of the department of psychiatry.

The inclusion and exclusion criteria for cases & control are shown in Fig. 1. The procedure for recruitment of the cases is as in Fig. 2.

Inclusion Criteria (cases)

1. Primary diagnosis of obsessive compulsive disorder as per MINI-KID 6

Chronological age between 6-18 years

Both sexes

2. Children and adolescents presenting to the child and adolescent psychiatry services or general psychiatric services and diagnosed to have OCD by a Consultant.
3. Willingness to participate documented through informed written consent and assent.

Exclusion Criteria (cases)

1. Not giving consent
2. Progressive neurological disorder
3. Children and adolescents with mental retardation and autistic spectrum disorder who cannot follow the instructions for eye tracking studies or understands the content of questionnaire, proforma or scales.
4. Children with ADHD, childhood onset schizophrenia or uncontrolled epilepsy.
5. History suggestive of sensory impairment (visual, auditory)

Healthy controls were recruited using the following inclusion and exclusion criteria:

Inclusion criteria (controls):

1. Age 6-18 years
2. Free of psychiatric abnormality as screened by MINI-Kid 6
3. Willingness to participate in the study as expressed by the child and parents (whichever is suitable according to age)

Exclusion criteria (controls):

1. Other gross physical/ medical problems that can have significant negative effect on child's performance
2. Progressive neurological condition
3. The family history of mood or anxiety disorders.
4. Not giving consent for the study.

Fig. 1. Inclusion & Exclusion criteria for the study.

2.2. Procedure

The cases and controls were evaluated by a semi-structured questionnaire assessing socio-demographic profile and MINI-KID 6.0 version screener for comorbidities (Sheehan et al., 2010).

2.2.1. Eye tracking methodology

The eye tracking experiments were done as per established standards (Subramaniam et al., 2017). We used a room with controlled luminance to conduct the eye tracking experiments. Before the eye movement recordings the ocular dominance was assessed. We used the hole-in-the-card-test (Dolman method) (Cheng et al., 2004) to identify the dominant eye. In this test, the participant had to hold a piece of cardboard with a central circular hole in front of his/her eye. They were asked to view a target at about 6 m away. First both the eyes were open, subsequently, each eye was occluded in turn. The target disappeared, when seen through the hole with the dominant eye covered and the cardboard is kept in same position; whereas, it persisted to be seen through the hole when the non-dominant eye was covered. In this test, there was only one result of dominance (left or right). The dominant eye was used to record eye tracking data of the subject.

A 22-inch flat screen monitor (FuzHion, Viewsonic, 120 Hz), placed 74.3 cm in front of the subject was used to display the stimuli. EyeLink 1000 eye-tracker (SR Research, Canada) was used to collect the eye tracking data, sampling at 1000 Hz. Chin rest and forehead abutments constrained the head movements. The saccadic tasks were based on the standard procedures and principles as described earlier (Taylor and Hutton, 2009). After being explained about the procedure, each participant performed a total of 24 prosaccade and 48 antisaccade trials. The stimuli for the trials were displayed on a screen with a black background. The stimuli was a circle (green in color for prosaccade, red in color for antisaccade) of 0.3 cm diameter. To start with, each trial had a circle located at the center of the screen, for a random duration (between 800 msec and 1200 msec). The trial would begin only if the subject fixated within a narrow fixation window i.e. 1° square region of visual angle (28 pixels x 28 pixels) around the central fixation point. After this delimited random interval, the central stimulus (fixation stimulus) disappeared, and following a gap of 200 msec, the target stimulus appeared. This target appeared randomly among ± 6 degrees and ± 12 degrees of visual angle from the center (Ettinger et al., 2006). For the prosaccade task, the subject was instructed to look at the target when it appeared, and for the antisaccade task the subject was told to look at the mirror image location of the target instead of looking at it.

Saccades with latencies outside the range of 80 msec to 600 msec after target onset were excluded for analysis (van Zoest et al., 2004) because these would have been either anticipation artifacts or inattention artifacts respectively. We also excluded trials in which though the first saccade is in the correct direction, but the eye looked close to the target during the trial, crossing the midline beyond the 1° fixation window. Trials containing random performance errors like subject looking out of screen or distorted corneal reflection were also considered non-analyzable. Antisaccade error percentage (percentage of analysable antisaccade trials that were erroneous), latency and amplitude gain of correct antisaccades (Rycroft et al., 2006), peak velocity of correct antisaccades (Ramchandran et al., 2004) and final eye position error (calculated by taking the absolute value of one minus final eye position gain for each trial. Final eye position gain is the ratio of final eye position to correct eye position) were used as performance

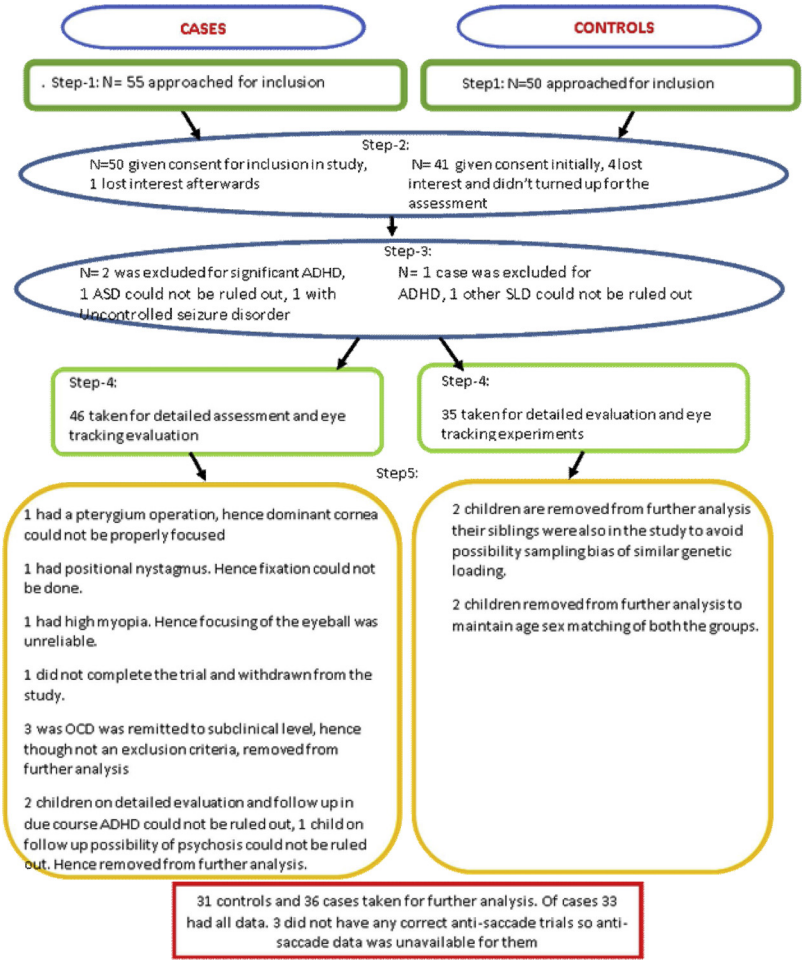

Fig. 2. Flowchart of case and control recruitment process.

measures in case of antisaccade tasks. The performance measures were similar for the pro saccade task also.

3. Results

3.1. Between-group analyses

Children with OCD had a mean age of 14.17 years whereas control group had mean age of 13.26 years; and the difference were not statistically significant (Levene's test: $p = 0.013$; *t*- test: $p = 0.201$).Likewise, children with OCD and control group children are not significantly different in terms of other socio demographic variables like sex ($p = 0.668$; χ^2 test), family income (Levene's test: $p = 0.407$; *t*-test: $p = 0.129$), father's education ($p = 0.928$; Exact Sig.), mother's education ($p = 0.634$; Exact Sig.), father's occupation ($p = 0.422$; Exact Sig.), mother's occupation ($p = 0.609$; Exact Sig.) also.

The eye movement parameters were not statistically significantly different between groups of children with or without OCD. (Tables 1 & 2)

3.2. Pan group analysis

3.2.1. Eye-tracking parameters were correlated

Tables 3 & 4 show all latency, gain, and peak velocity measures in anti-saccade primary saccade and first correct saccade were strongly correlated ($r = 0.7$, $p < 0.01$), which signified measuring similar entities. Also anti-saccade final eye position gain and anti-saccade position errors were strongly correlated and not only that, they had been correlated with anti-saccade primary saccade amplitude gain strongly also ($r = 0.7$, $p < 0.01$). Anti-saccade gain and peak velocity were directly related. So they also signified related entities ($p < 0.01$, but $r < 0.7$). Overall, anti-saccade latency was inversely correlated significantly with gain and peak velocity parameters.

In pro-saccade parameters, latency, peak velocity, and amplitude gain in primary saccade and first correct saccade were strongly correlated ($r > 0.7$), as were the final gain and position errors. But overall though amplitude gain and peak velocity parameters were significantly positively correlated ($0.5 > r > 0.4$) as anti-saccade counterparts, but they had no significant correlations with latency parameters or final gain and position error parameters.

3.2.2. Relation of eye tracking parameters with age

Anti-saccade error percentage, was inversely correlated with continuous age variable in normal control ($r = -0.391^*$, $p = 0.03$). However, this trend got diluted in total sample ($r = -0.206$, $p = 0.09$) due to complete lack of such association inpatient population ($r = 0.031$).

The contrary was true for all gain parameters of anti-saccade tasks. Here the inverse trend of these parameters with age is stronger in the patient population than in normal controls.

In fact, all anti-saccade task parameters are negatively related with age in normal controls. Error rate ($r = -0.391^*$), latency (mean primary saccade latency, $r = -0.171$, mean first correct saccade latency, $r = -0.119$) and gain (mean primary saccade amplitude gain, $r = -0.120$, mean first correct saccade amplitude gain, $r = -0.094$ fin.l eye position gain $r = -0.190$, position error $r = -0.144$)

Table 1
Anti-saccade parameters between case and control group comparison.

	Case (n = 36)	controls (n = 31)	Mean Difference	95% Confidence Interval of the Difference		p value(*t*-test or Mann-Whitney's as applicable
	Mean ± SD			Lower	Upper	
Anti-saccade error percentage	66.7573 ± 20.82665	68.9815 ± 20.50288	−2.22429	−12.3428	7.89427	.554 (M-W *U* test)
Anti-saccade mean primary saccade latency	274.3661 ± 79.79852	267.9891 ± 96.28860	6.37704	−37.7036	50.45769	.541 (M-W *U* test)
Anti-saccade mean first correct saccade latency	238.0161 ± 58.43596	233.5734 ± 77.60221	4.44270	−29.7484	38.63384	.456 (M-W *U* test)
Anti-saccade mean primary saccade peak velocity	372.2502 ± 74.03822	399.1707 ± 112.50820	−26.92052	−74.2324	20.39138	.260 (*t*- test)
Anti-saccade mean first correct saccade peak velocity	352.4169 ± 78.36308	389.6038 ± 113.66204	−37.18693	−85.7155	11.34167	.131 (*t*-test)
Anti-saccade primary saccade amplitude gain	1.5230 ± .59148	1.5537 ± 0.58253	−.03074	−.32432	.26284	.835 (*t*- test)
Anti-saccade mean first correct saccade amplitude gain	.45847	1.4592 ± 0.57799	−.06272	−.32259	.19714	.631 (*t*-test)
Anti-saccade final eye position gain	1.4312 ± .60496	1.4590 ± 0.44819	−.02773	−.29516	.23970	.448 (M-W *U* test)
Anti-saccade position error	.6309 ± .50025	.6354 ± 0.40211	−.00446	−.23216	.22324	.702 (M-W *U* test)

Table 2
Pro-saccade parameters between case and control group comparison.

	Case (n = 36)	Controls (n = 31)	Mean Difference	95% Confidence Interval of the Difference		p-value (*t*-test or Mann-Whitney's U as applicable)
	Mean ± SD			Lower	Upper	
Pro-saccade error percentage	1.9561 ± 3.29427	1.8121 ± 3.14521	.14399	−1.43479	1.72277	.852 (M-W *U* test)
Pro-saccade mean primary saccade latency	153.8528 ± 31.67406	156.9134 ± 29.03082	−3.06060	−17.9770	11.85584	.615 (M-W *U* test)
Pro-saccade mean first correct saccade latency	144.0756 ± 26.04323	148.9163 ± 27.62668	−4.84070	−17.9480	8.26669	.407 (M-W *U* test)
Pro-saccade mean primary saccade peak velocity	342.5829 ± 66.90713	328.2123 ± 51.68805	14.37067	−15.1668	43.90823	.308 (M-W *U* test)
Pro-saccade mean first correct saccade peak velocity	339.2401 ± 68.32851	326.9566 ± 50.85919	12.28348	−17.5134	42.08042	.443 (M-W *U* test)
Pro-saccade mean primary saccade amplitude gain	.9141 ± .08943	.9177 ± .06321	−.00368	−.04206	.03470	.849 (*t*-test)
Pro-saccade mean first correct saccade amplitude gain	.9057 ± .09417	.9117 ± .06473	−.00599	−.04607	.03409	.960 (M-W *U* test)
Pro-saccade final eye position gain	.9404 ± .07466	.9362 ± .13202	.00425	−.04718	.05568	.466 (M-W *U* test)
Pro-saccade position error	.1343 ± .06441	.1532 ± .12011	−.01892	−.06747	.02963	.890 (M-W *U* test)

Table 3
Correlations between anti-saccade parameters in the sample.

	Anti-saccade uncorrected error percentage among total trials	Anti-saccade uncorrected error percentage among total errors	Anti-saccade error percentage	Anti-saccade mean primary saccade latency	Anti-saccade primary saccade amplitude gain	Anti-saccade mean first correct saccade latency	Anti-saccade mean first correct saccade amplitude gain	Anti-saccade mean primary saccade peak velocity	Anti-saccade mean first correct saccade peak velocity	Anti-saccade final eye position gain	Anti-saccade position error
Anti-saccade uncorrected error percentage among total trials	1	.968**	.454**	.409**	.127	.253*	.056	−.219	−.288*	.093	.229
Anti-saccade uncorrected error percentage among total errors	.968**	1	.337**	.377**	.139	.240	.084	−.204	−.267*	.103	.231
Anti-saccade error percentage	.454**	.337**	1	.283*	−.004	.156	−.125	−.117	−.171	.034	.073
Anti-saccade mean primary saccade latency	.409**	.377**	.283*	1	−.121	.697**	−.335**	−.298*	−.403**	.122	.206
Anti-saccade primary saccade amplitude gain	.127	.139	−.004	−.121	1	−.436**	.875**	.617**	.455**	.765**	.757**
Anti-saccade mean first correct saccade latency	.253*	.240	.156	.697**	−.436**	1	−.373**	−.469**	−.376**	−.206	−.190
Anti-saccade mean first correct saccade amplitude gain	.056	.084	−.125	−.335**	.875**	−.373**	1	.600**	.603**	.560**	.504**
Anti-saccade mean primary saccade peak velocity	−.219	−.204	−.117	−.298*	.617**	−.469**	.600**	1	.930**	.365**	.376**
Anti-saccade mean first correct saccade peak velocity	−.288*	−.267*	−.171	−.403**	.455**	−.376**	.603**	.930**	1	.197	.164
Anti-saccade final eye position gain	.093	.103	.034	.122	.765**	−.206	.560**	.365**	.197	1	.916**
Anti-saccade position error	.229	.231	.073	.206	.757**	−.190	.504**	.376**	.164	.916**	1

* means Correlation Significance $p < 0.05$.** means Correlation Significance $p < 0.01$.

Table 4
Correlation between the pro-saccade parameters in the sample.

	Pro-saccade uncorrected error percentage among total trials	Pro-saccade error percentage	Pro-saccade mean primary saccade latency	Pro-saccade mean primary saccade amplitude gain	Pro-saccade mean primary saccade peak velocity	Pro-saccade mean first correct saccade latency	Pro-saccade mean first correct saccade amplitude gain	Pro-saccade mean first correct saccade peak velocity	Pro-saccade final eye position gain	Pro-saccade position error
Pro-saccade uncorrected error percentage among total trials	1	.348**	.072	.187	.024	.098	.122	.019	−.139	.101
Pro-saccade error percentage	.348**	1	.108	.213	.085	.209	.190	.091	.070	−.094
Pro-saccade mean primary saccade latency	.072	.108	1	.113	.013	.730**	.017	−.020	.066	.044
Pro-saccade mean primary saccade amplitude gain	.187	.213	.113	1	.433**	.300*	.976**	.432**	.074	.071
Pro-saccade mean primary saccade peak velocity	.024	.085	.013	.433**	1	.161	.463**	.995**	.152	−.015
Pro-saccade mean first correct saccade latency	.098	.209	.730**	.300*	.161	1	.315**	.168	.114	−.007
Pro-saccade mean first correct saccade amplitude gain	.122	.190	.017	.976**	.463**	.315**	1	.476**	.098	.036
Pro-saccade mean first correct saccade peak velocity	.019	.091	−.020	.432**	.995**	.168	.476**	1	.146	−.019
Pro-saccade final eye position gain	−.139	.070	.066	.074	.152	.114	.098	.146	1	−.897**
Pro-saccade position error	.101	−.094	.044	.071	−.015	−.007	.036	−.019	−.897**	1

* means Correlation Significance $p < 0.05$.** means Correlation Significance $p < 0.01$.

decreased with age in normal controls. Peak velocity was actually uncorrelated with age (very minimal inverse trend) (mean primary saccade peak velocity r = −0.041, mean first correct saccade peak velocity r = −0.011).

Whereas in children with OCD, inverse relation of gain parameters (mean primary saccade amplitude gain, r = −0.419*, mean first correct saccade amplitude gain, r = −0.403*, final eye position gain r = −0.396*, position error r = −0.497**) and to some extent peak velocities also (mean primary saccade peak velocity r = −0.154, mean first correct saccade peak velocity r = −0.169) were more whereas, other parameters especially latency (mean primary saccade latency, r = 0.218, mean first correct saccade latency, r = 0.311), had a reverse or positive correlation trend.

4. Discussion

This case-control study was done to explore the role of eye tracking parameters as a putative biomarker in children with OCD.

4.1. Comparison of eye tracking parameters between cases and healthy controls

The previous study withOCD patients found no abnormalities in pro-saccade tasks but in anti-saccade tasks, there were no latency abnormality but more anti-saccade errors were found in OCD patients (Rosenberg et al., 1997a,b). But in present study there was no statistically significant difference in cases and controls in eye tracking parameters.

Jaafari et al. (2011) pointed out that, anti-saccade errors were secondary to abnormalities in DLPFC, which is classical in schizophrenia that is associated with error rate abnormality but OCD is not known to be associated with DLPFC abnormalities so strongly. Hence error rates in OCD were not expected to be different than normal control (Jaafari et al., 2011). It supports the result of our present study.

Previous juvenile OCD study (Rosenberg et al., 1997a,b) was an old study with quite a few methodological differences from the current study. These differences include the use of an older electro-oculography instrument, the inclusion of ADHD as a co-morbidity, inclusion of only, those subjects who were medication naïve and a small sample size of 9 cases and 9 healthy controls. Hence the result of the current study can be different from the previous paediatric OCD study. Which has happened in reality.

4.2. Maturational effect of eye movement parameters

In the study sample, all the parameters in anti-saccade trials were negatively correlated with age in normal controls, as previous studies suggested (Luna et al., 2008). Peak velocity had the weakest correlation, though none of these parameters were significantly correlated with age, the trend was quite prominent in all the eye movement variables. That shows like other biological entities eye-tracking parameters also matures with age.

This study suggested that, as the children grow, they could perform the anti-saccade task with less error (i.e. error rate negatively correlated with age), slightly slowly (i.e. peak velocity had a weak negative correlation with age) but they were faster in giving correct responses (latency negatively correlated with age).They also did the tasks more accurately. Saccadic final position gain negatively correlated with age. That means, ratio of final eye position and correct eye position decreases with age (Vide Section 2.2.1). Anti-saccades were found to be hypermetric (gains were > 1) consistently in the sample. Hence decrease in gain with age meant, that with increased age they were coming closer to one. That means, final eye position was closer to the correct eye position that meant they were becoming more accurate. This clear maturational trend underscored that eye-tracking parameters were similar to other biological parameters and change with age.

In case of pro-saccade parameters, they had less clear biological trends. Some related parameters were correlated in a reverse manner. For example, mean primary saccade parameters were correlated more like anti-saccades (i.e. inversely with age) except gain parameters which were positively correlated. This also could be explained by the fact that here the saccades were hypo metric, (i.e. gain < 1) as suggested by a relevant review (Luna et al., 2008). A positive correlation here meant it was becoming more accurate (closer to one). But first correct saccade was behaving on the contrary, i.e. not much correlated. Here, mean ± SD of saccade latency of first correct saccade in the pro-saccade tasks was around 148 ± 27 ms, while mean ± SD of primary saccade latency was 156 ± 29 ms. Hence it was clear that lot more of those first correct saccade in the pro-saccade tasks was 'express saccades' having latency < 140 ms. According to relevant reviews express saccades had far less prominent maturational change (Klein et al., 2005; Luna et al., 2008). Those express saccades could have diluted the maturational trend that might have existed in those first correct pro-saccades.

4.3. Latency and gain—is something being missed!

In our study, in normal controls, all anti saccade parameters were inversely proportional with age (though velocities had virtually no relationship). But in children with OCD latency parameters were directly proportional with age. So there was a clear change of trend in latency parameters in children with OCD from normal controls. Though none of these was statistically significant, the sample mean of latency in cases was more than the controls. But unlike previous adult trials, it was not significant. The question remains, whether the inverse relation with age overshadowed some mild disease-related increase in case of latency parameters? Though taking age as a covariate also, 'mean first correct saccade latency' was not significant (for age p = 0.561; for diseased state p = 0.729).

The inverse relationship of age with gain parameters in the anti-saccade task was exacerbated in cases in comparison to control. This association is quite interesting, and while no previous study had explored 'gain' in anti-saccade tasks in OCD, hence previous data was not available. But this relationship was worth noting and could be explored in future studies.

Probably strongest theoretical support came from schizophrenia eye tracking literature. Where it was noted that anti-saccade gain and latency in schizophrenia were associated with the caudate volume, i.e. larger caudate volume was associated with hypo metric gain (< 1) and longer latencies (Ettinger et al., 2004). Basal ganglia and caudate lobe were also associated with OCD to a large extent (Aouizerate et al., 2004). Hence it may be an expected finding to have gain & latency abnormalities of the anti-saccade task in patients with OCD. Age-related normal change might have masked the disease associated change in this situation. Though in this case also, taking age as a covariate ANCOVA did not yield a significant result for 'mean first correct saccade amplitude gain' (for age p = 0.103, disease state, p = 0.826).

Though the sample size is larger than most of the other similar studies, it still can improve. A potential confounding fact is that some in our sample are not drug naïve.

This study is the only study till date in pediatric OCD with modern eye-tracking instruments. As it has explored an uncharted territory, it will give directions to a lot of future studies in this area.

In further studies, larger sample size can be taken and the sample can be stratified by age to nullify age effect completely on the parameters. A cohort study can give the variability of these parameters across time. A pre-post treatment design can explore if it can be used as a prognostic marker or not.

5. Conclusion

Eye tracking task is a useful research tool in children in addition to

being non-invasive and safe. Eye tracking parameter changes with age, which underlines its validity as a biological parameter. In view of findings related to anti saccade gain and latency in this study, it is worthwhile to explore these parameters in a larger sample of children and adolescents with OCD, who are medication naïve along with matched healthy controls.

Disclosure

All the author approved the final manuscript and all of them contributed significantly towards the article. No relevant financial disclosure exist.

Conflict of interest

None.

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