

Comparison of AC/A Ratio in True and Simulated Divergence Excess Exotropia

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ABSTRACT

Purpose: To compare the accommodation convergence per accommodation ratio (AC/A) in true and simulated divergence excess exotropia.

Study Design: Comparative cross sectional study.

Place and Duration of Study: Department of ophthalmology, Punjab Rangers teaching hospital, Lahore, from July 2019 to December 2019.

Methods: The study included 20 patients each of intermittent exotropia (XT) true and simulated divergence excess exotropia (XT). All the subjects underwent complete orthoptic assessment that included AC/A ratio calculation through heterophoria method after monocular occlusion.

Results: The Results showed that patients with true divergence excess exotropia have a high AC/A ratio as compared to patients with simulated divergence excess exotropia who have a normal AC/A ratio. 57% patients showed true divergence excess exotropia with high AC/A ratio while 43% had divergence excess with normal AC/A ratio.

Conclusion: The response of AC/A was found to be higher in patients with true divergence excess exotropia after monocular occlusion.

Key Words: Intermittent exotropia, True simulated divergence excess exotropia, simulated divergence excess exotropia.

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INTRODUCTION

The control of squint depends upon different factors such as the distance of fixation fatigue, bright light, concentration and ill health.¹ In Intermittent exotropia, eyes remain straight with binocular single vision at

some times and manifest suppression at other times. Presentation is usually around age of 2 years with exophoria which breaks down to tropia under above mentioned circumstances.² In distance exotropia, deviation of eyes is greater at distance than near and increases further beyond 6 meters. It is further classified into two as true divergence excess exotropia and simulated divergence excess exotropia.³

In true divergence excess exotropia the distance deviation is greater than near deviation before and after patch test. The difference of distance and near is almost 10 prism diopters. In cases of simulated divergence excess exotropia, the near deviation equals distance deviation after patch test of 30 minutes.⁴ Patch test differentiate between true divergence and

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simulated divergence excess exotropia. Monocular occlusion eliminates the tenacious proximal fusion.⁵

All the cases of divergence excess exotropia donot have true divergence excess exotropia. Monocular occlusion of 30 to 60 minutes reveals large deviation at near in cases of simulated divergence exotropia.⁶ When a patient shows large deviation at near after monocular occlusion test it is called tenacious proximal fusion and when a patient shows a small deviation after prolonged patch test this is called high AC/A ratio. But when patients show same amount of deviation after patch of 3D lenses, it is called proximal convergence, which is True Convergence Excess.⁷

AC/A ratio are the amount of accommodative convergence induced by each diopters of accommodation exerted and is measured in prism diopters. Normal range of AC/A ratio is 2-4. The relationship of AC/A ratio is fixed and remains unchanged from childhood till the age of presbyopia. The AC/A ratio can be modified permanently by surgery of the extra ocular muscles and temporarily by drugs and lenses.⁸ Different methods are used to measure AC/A ratio; heterophoria method, gradient method, fixation disparity method and graphical method. Most common method is heterophoria method in which a prism cover test is performed for distance and near fixation. Inter-pupillary distance is measured. A positive sign is used for esotropia and negative sign is used for exotropia.

$$AC/A \text{ ratio} = IPD \text{ (in cm)} + \frac{\text{Near PCT} - \text{distance PCT}}{\text{Amount of accom. Exerted}}$$

The patch test is used to control the tonic fusional convergence to differentiate pseudo-divergence excess from true divergence excess and to reduce the angle variability. Contrary to the earlier practice of patching one eye for 24 hours, it is now found that patching the eye for 30 minutes is sufficient to suspend the tonic fusional convergence and thus reveals the actual amount of deviation.⁹ Comparison of distance and near deviation is important part of evaluation in strabismus. In majority of esotropic patients, the difference of distance and near deviation shows a normal linkage of convergence and accommodation and this relation can be explained by AC/A ratio. In cases of intermittent exotropia it is different because many are slow to dissipate proximal fusion mechanism which prevents them from manifesting true near deviation during a brief cover test.¹⁰ If a patch test is not performed in cases of intermittent exotropia before surgery they

may develop cyclic esotropia with high AC/A ratio.¹¹

Rationale of the study was to compare the accommodative convergence per unit accommodation ratio (AC/A) in true and simulated divergence excess exotropia in Pakistani patients.

METHODS

In this analytical, comparative cross sectional study, patients with divergence excess exotropia presenting in the orthoptics clinic of ophthalmology department of Punjab Rangers Teaching Hospital, Rahbar Medical and Dental College were enrolled. Patients with constant and basic type of deviations were excluded. The minimum age chosen for study was 5 years and maximum 30 years to ensure maximum cooperation. Examination included Visual acuity (VA) record by using Log MAR chart. VA was recorded in adults using alphabets. In young children using picture charts and in illiterates with tumbling E chart. All the subjects underwent complete orthoptic assessment and cycloplegic refraction when required. AC/A ratio were calculated using heterophoria method. For all measurements, patient and observer were at same eye level with good room illumination. For distance measurements, patient was seated at 6meters. Fixation target at Log MAR chart was 2 lines above the best corrected visual acuity to maintain accurate fixation. Patient was asked to fixate at a distant target and prism was placed in front of deviated eye. Alternate prism cover test was performed. Prism power was increased until there was no movement of eyes to take up fixation. Amount of deviation at distance was calculated. A patch test of 30 minutes was performed in each patient. One eye was occluded for half an hour, deviation was measured again for near and any change in deviation was noted. Inter-pupillary distance was measured by instructing the patient to see straight ahead. AC/A ratio was calculated by formula described above. All the collected data was noted and analyzed by using SPSS 22 version.

RESULTS

AC/A ratio was high in true divergence excess exotropia (28.21%) and normal in simulated divergence excess exotropia (13.19%) Table 1. Table 2 shows that there was significant difference between true and pseudo divergence excess exotropia. AC/A ratio was normal in cases of simulated divergence

Table 1: Group Statistics.

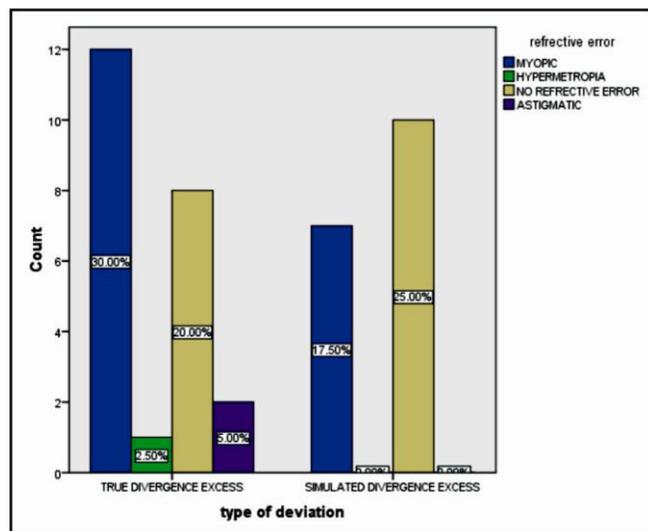
	Type of Deviation	N	Mean	Std. Deviation	Std. Error Mean
Accommodative convergence /accommodation	True divergence excess	23	11.0739	1.93537	0.40355
	Simulated	17	5.1765	0.24630	0.05974
Interpupillary distance	True divergence excess	23	5.3913	0.47569	0.09919
	Simulated divergence excess	17	5.1765	0.24630	0.05974

Table 2: Independent Samples Test.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
AC/A	Equal variances assumed	15.910	0.000	12.448	38	0.000	5.89744	0.47377	4.93835	6.85654
	Equal variances not assumed			14.456	22.959	0.000	5.89744	0.40795	5.05345	6.74143
Inter-pupillary distance	Equal variances assumed	30.268	0.000	1.698	38	0.098	.21483	0.12655	-0.04136	0.47102
	Equal variances not assumed			1.855	34.595	0.072	.21483	0.11579	-0.02033	0.44999

excess exotropia and high AC/A ratio was recorded in true divergence excess exotropia. (t = 12.448, df 38, p = 0.000).

exotropia and 17.50% were myopic in simulated. In both groups 20% to 25% were emmetrope.



This graph shows that most of the patients of true and simulated divergence excess exotropia were myopic or without refractive errors. Thirty percent of patients were myopic in true divergence excess

DISCUSSION

The study was designed to differentiate the cases of true divergence excess exotropia from simulated divergence excess exotropia by performing a patch test and measuring AC/A ratio by heterophoria method. Apparently both types of cases show high AC/A (accommodative convergence per unit accommodation) ratio prior to patch test but post monocular occlusion test the results are different. Patch test reveals the real amount of deviation at near.¹² It is generally believed that AC/A ratio was found higher in divergence excess exotropia type. Over 75% of patient have increase in near deviation after patch test and decrease in calculated AC/A ratio.¹³

By using standard methods, Cooper and Coworkers calculated AC/A in patients of intermittent exotropia. Patient first underwent a monocular occlusion of one hour for measurement of actual near deviation.^{14,15} If the patient had high AC/A ratio before occlusion test but had normal AC/A ratio after monocular occlusion test they described these cases as pseudo high AC/A ratio. If tenacious proximal fusion

was not suspended, the near measurements were contaminated in patients of exotropia.^{16,17}

In addition to the factors enumerated by Scobee to explain this phenomenon, we believe that extremely active convergence tonus during childhood may be a factor in obscuring the exodeviation at near fixation. This mechanism enables patients with a basic deviation to keep their eyes aligned for near vision but not for distance vision, where convergence is less active. Momentary disruption of fusion by alternately covering each eye rapidly in prism cover test or alternate cover test is not enough to break the compensatory mechanism that have been developed in years. Kushner introduced the term "tenacious proximal fusion" for the persistent convergence innervation that hides the exodeviation at near fixation. This term seems awkward and does not add to the clarification of the issue. The term "convergence aftereffect" is a more appropriate description of this phenomenon.^{18,19}

In another study which was conducted to evaluate the diagnostic method of divergence excess exotropia, 237 patients were evaluated. They were divided into two groups according to their response to monocular occlusion and the use of +3.00 diopters add at near. They observed that in ten patients there was increase in deviation in both tests. They considered these cases as simulated divergence excess exotropia and ten patients who did not respond to monocular occlusion and remained unchanged, these were the True divergence excess exotropia patients.²⁰

To review the multiple factors responsible for the discrepancy in distance and near deviation, two clinical tests (occlusion test and +3.00 diopter lens) were described. Patients with intermittent exotropia usually have more deviation at distance as compared to near, and these cases have high AC/A ratio after occlusion of one eye and with the use of +3.00 spheres at near.¹⁸

CONCLUSION

The response of AC/A was found to be higher in patients with true divergence excess exotropia after monocular occlusion.

Ethical Approval

The study was approved by the Institutional review board/Ethical review board. (EC Ref No: 01/18).

Conflict of Interest

Authors declared no conflict of interest.

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Authors' Designation and Contribution

Sana Sagheer; Orthoptist: *Concepts, Design, Literature search, Data acquisition, Data analysis, Manuscript review.*

Muhammad Ali Haider; Assistant Professor: *Literature search, Manuscript preparation, Manuscript editing, Manuscript review.*

Attaullah Shah Bukhari; Assistant Professor: *Data analysis, Statistical analysis, Manuscript review.*

Uzma Sattar; Investigative Occulist: *Manuscript editing, Manuscript review.*

Iftikhar Ahmed; Professor: *Manuscript editing, Manuscript review.*

