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Full Length Research Paper

Clinical Characteristics of Intermittent Exotropia

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Purpose: To examine the clinical characteristics of intermittent exotropia in subjects of 6 to 30 years old.
Design: A cross sectional study
Methods: A study was conducted at Binocular Vision Clinic in Hospital Universiti Kebangsaan Malaysia (HUKM) which involved 30 subjects in intermittent exotropia group and 30 subjects from control group. Non-probability sampling was applied. The ocular parameters included refractive error, measurement of visual acuity for distance and near, assessment of ocular deviation at near and distance employing the cover test and prism cover test, measurement of negative and positive fusional reserves using a prism bar and measurement of amplitude of accommodation using RAF rule. Other than that the ocular motility at nine positions of gaze was also examined, including assessment of binocularly by means of a TNO test for near vision and a Worth-4-Dots test for distant vision. Independent t test and Mann whitney test were used in data analysis.
Results: There were significant differences for visual acuity at 6m, amplitude of accommodation, vergence for 6m and 40cm for prism cover test, stereopsis and near point convergences (NPC) between intermittent exotropia and control groups.
Conclusion: The findings concluded that female are the most common in both groups' intermittent exotropia subjects and the non squint subjects and the majority is Malay subjects.

Keywords: Exotropia, ocular parameters, clinical characteristics, Malaysia, ethnicity

INTRODUCTION

Exodeviation is an ocular anomaly when the visual axis is not directed on an object of regard. In exodeviation, the visual axis deviates outwards, that is, towards the temporal. Exodeviation occurs as a result of certain obstacles to development or maintenance of binocular vision. It can also occur due to defective action of the medial rectus muscles. There are two types of exodeviation which include exophoria and exotropia. Exophoria is an exodeviation of an eye that occurs during in a hidden condition which is also known as a latent exodeviation. Exotropia, on the other hand, is an

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exodeviation that occurs in a manifest condition which is also known as divergent squint [1].

Small exophorias are found in high frequency in the normal population and 60-70% of normal newborn infants have a transient exodeviation that resolves by 4 to 6 months of age [1]. Exotropia is a manifest divergence of visual axes in one or both eyes. Exotropia occurs in 1 to 2% of pediatric population [2].

Exotropia is about one third as common as esotropia and more prevalent in the Middle East, Asia and Africa. Nepal appears to have the highest incidence of exotropia as compared to esotropia by 76.0% [3]. Francis (2003) reported that many children have transient exotropia in the first week of life that can be regarded as a variant of normal development and intermittent exotropia present before the age of 18 month. It was also reported that closure of one eye in sunlight may be due to respond of the glare or any disorder of retina, optic nerve, refractive media, pupil and showed the family history of strabismus and small degree of exophoria can be controlled [4].

The previous study of intermittent exotropia remains obscure due to lack of longitudinal prospective studies and only a few retrospective studies of untreated intermittent exotropia. Brian & Roland (2003) studied the most common forms of childhood strabismus using demographic and clinical data and found that intermittent exotropia was the most common forms of divergent strabismus in this population [5]. They represented 47.7% of 249 of childhood exotropia. Chia *et al* (2005) reported a retrospective review of 287 consecutive children in Singapore presenting with intermittent exotropia. Their study found that half of the patients with an intermittent exotropia eventually had surgery [6].

Greenberg *et al* (2007) reported clinical characteristics of childhood strabismus from a population cohort study. The result of their study showed that accommodative esotropia and intermittent exotropia were the predominant forms of strabismus in this population and represented by 61.0% esotropia, 32.0% exotropia, 7.0% hypertropia and intermittent exotropia contribute 16.8% [7]. Nusz *et al* (2005) evaluated gender differences among children diagnosed with intermittent exotropia and found that intermittent exotropia was predominantly female. Their study showed that 108 (64.1%) of the 184 patient were girls [8].

A study by Sarah *et al* (2007) which aimed to evaluate distance stereoacuity in intermittent exotropia using the Frisby Davis Distance stereo test (FD2) found that patients with intermittent exotropia can achieve normal levels of distance stereoacuity, but a considerable proportion, despite comprehending, showed a negative response [9].

Sarah *et al* (2008) also reported in a study which involved 12 patients in order to assess the variability of stereoacuity over one day in children with exotropia using the Frisby Davis Distance test and the Distance Randot test at distance, and the Frisby and Preschool Randot tests at near, and they emphasized that half of children with exotropia show marked changes in stereoacuity over the course of a single day [10].

In some cases, an exophoria progresses to an intermittent exotropia that eventually becomes constant. Such deviation usually occurs first at distance and later at near fixation. They may be influenced by decreased tonic convergence with increasing age, the development of suppression, loss of accommodative power and increasing divergence of orbit with advancing age. Nevertheless, not all intermittent exotropia are progressive. In some cases, the deviation may remain stable for many years, and in a few cases, it may even improve. Thus the patient should be followed over time to determine whether their exotropia is stable or deteriorating. Von Noorden found that 75.0% of 51 untreated patients showed progression over an average follow up period of 3.5 years while 9.0% did not change, and 16.0% improved [11].

Among the studies, there was lack of study comparing the clinical characteristics of intermittent exotropia between non squint groups and intermittent exotropia groups within Malaysia populations. The purpose of this study was to examine the clinical characteristics of intermittent exotropia comparing it with normal subjects.

METHODS

A cross sectional study was carried out among 30 intermittent exotropia patients and 30 normal subjects as control group. This study was conducted at Binocular Vision Clinic in Hospital Universiti Kebangsaan Malaysia (HUKM). Non-probability sampling was applied in selecting the subjects in the study. Patients with best visual acuity of right eye and left eye (6/9 or better), with no previous squint surgery or vision therapy, no ocular disease and in good general health were included in the study. Any patient that come to the clinic who meet inclusion and exclusion criteria was selected in the study.

The ocular parameters which included refractive error, visual acuity, ocular deviation and distance, fusion vergence (negative fusion version (NFV) and positive fusion version

Table (1). Demographic characteristics of the subjects

Characteristics	Intermittent Exotropia (n=30)		Control (n=30)	
	Mean (SD)	n (%)	Mean (SD)	n (%)
Age (years)	13.00 (4.40)		17.60 (7.10)	
Gender				
Male		12 (40.0)		14 (46.7)
Female		18 (60.0)		16 (53.3)
Race				
Malay		18 (60.0)		22 (73.7)
Chinese		8 (26.7)		6 (20.0)
Indian		4 (13.3)		2 (6.7)

(PFV)), amplitude of accommodation (AA), near point of convergence (NPC), ocular motility test at nine position of gaze, binocularity at far and binocularity at near were measured for each of the subjects. Refractive error was measured by using retinoscopy and refined subjectively using the crossed-cyl technique. Retinoscopy was performed to determine the distance refractive error of the subject's eyes. Visual acuity was measured by using Snellen chart. The test was done by record visual acuity for each eye and record the patient distance acuity first followed by near acuity. The entire Snellen fractions were converted to the logMAR equivalent according to Benjamin (1998) [12].

The ocular deviation was measured by using Cover Test and Prism Cover Test (PCT). These tests allow the examiner to differentiate tropias from phorias, assess the degree of control of a deviation, note fixation preference and strength of fixation for each eye. The Fusion vergence was measured by using Prism Bar to see if the subjects can overcome the deviation or not. For amplitude of accommodation, it was measured by the push-up and push-down technique using RAF rule. Subject was request to read the words on paragraph of N5 line on the drum of RAF rule target. With the RAF rule in place, the target is move from 50 cm to the point where the first line became slightly blurred. The value of AA was taken as the first measurement in diopter (D). Then, the target was slowly pushed back till subject indicates that it is clear and harp. This point was taken as the second measurement of AA in diopter (D). The record value of AA taken for the study was determined by the average of two values (push-up amplitude as in the first measurement and push-down amplitude as in the second measurement).

Near point of convergence (NPC) was also measured by using RAF rule. The subject fixated at black dot which located along the line and the researcher pushed up and pushed down the target until the subjects saw double or blurred and the finding was recorded. Motility test was carried out by asking the subjects to look at a pentorch which was moved in the motor field, while they were asked to follow it with the eyes without moving the head. Another ocular parameter was binocularity at far which was measured by using worth-4-Dots. Binocularity refers to the ability of both eyes to track the same objects at the same time. On the other hand, for binocularity at near was measured by using TNO test. The test was done by asking the subjects wore the Polaroid glasses or red-green glasses and hold the stereo target at 40 cm.

The data was collected by single researcher and was recorded in data collection form. This study received approval from the ethics committee of Universiti Kebangsaan Malaysia.

Statistical Analysis

Statistical Program for Social Science Software (SPSS), version 12.0.1, was used for data entry and data analysis. All the data were double checked and cleaned to verify the entire variables were properly documented and to detect any missing values during data entry. Exploration of data was then conducted to obtain descriptive statistics and necessary graphs for all the variables. The numerical variables were explored for normality distribution. For all numerical variables with normal distribution, their mean and standard deviation (SD) were obtained. However for numerical variables that histogram showed skewed graph, their median with inter-quartile range were then calculated. Independent t test was used to compare the mean values of ocular parameters between two groups (control and intermittent exotropia groups). On the other hand, for data that was not normally distributed, Mann-whitney test was used. The significance value was set at 0.05.

RESULTS

The demographic characteristics of the subjects are shown in Table 1. A total of 30 subjects in the intermittent exotropia group and 30 subjects in the control group were recruited in the study. The mean age for subjects in the intermittent exotropia group was 13.00 (4.40) years, whilst for the control groups was 17.60 (7.10) years. More than half of the subjects were females for both of the groups. Majority of them were Malays in both groups.

Table (2). Comparison of ocular parameters between control (n=30) and intermittent exotropia groups (n=30)

Test	Groups	Mean (SD)	Median (IQR)	Statistics	p-value
Spherical equivalent (RE)	Control		-1.06 (3.56)	-0.44	0.657 [a]
	(X) T		-0.94 (3.44)		
Spherical equivalent (LE)	Control		-0.75 (2.59)	-1.40	0.160 [a]
	(X) T		-1.50 (4.06)		
Visual acuity at 6m (RE)	Control		0.00 (0.10)	-3.22	0.001 [a]
	(X) T		0.00 (0.20)		
Visual acuity at 6m (LE)	Control		0.00 (0.10)	-2.98	0.003 [a]
	(X) T		0.00 (0.13)		
Visual acuity at 40cm (RE and LE)	Control		0.40 (0.00)	-	-
	(X) T		0.40 (0.00)		
Amplitude of accommodation (RE)	Control	11.06 (2.87)		-3.33	0.002 [b]
	(X) T	13.64 (3.12)			
Amplitude of accommodation (LE)	Control	10.83 (2.77)		-3.86	<0.001 [b]
	(X) T	13.78 (3.12)			
Vergence at 6m					
PCT	Control		0.00 (1.00)	-5.66	<0.001 [a]
	(X) T		15.00 (11.75)		
PFV	Control		10.00 (7.00)	-9.22	0.357 [a]
	(X) T		14.00 (12.00)		
NFV	Control		-16.00 (8.00)	-0.83	0.420 [a]
	(X) T		-9.00 (10.00)		
Vergence at 40cm					
PCT	Control		2.00 (3.00)	-5.86	<0.001 [a]
	(X) T		12.00 (10.00)		
PFV	Control	20.63 (13.05)		0.70	0.482 [b]
	(X) T	24.73 (11.50)			
NFV	Control		-12.00 (8.00)	-1.65	0.097 [a]
	(X) T		-13.00 (8.25)		
Stereopsis	Control		60.00 (0.00)	-2.75	0.006 [a]
	(X) T		90.00 (18.00)		
NPC	Control		6.00 (1.00)	-2.71	0.007 [a]
	(X) T		6.00 (2.17)		

[a] Mann-whitney test was applied

[b] Independent tetst was applied

Table 2 shows the comparison of ocular parameters between control and intermittent exotropia groups. The results reported there were significant differences for visual acuity at 6 m, amplitude of accommodation, vergence for 6m and 40cm for prism cover test, stereopsis and near point convergences (NPC) between intermittent exotropia and control groups. However, there were no significant different for spherical equivalent of the refractive error, vergence for 6m and 40cm for PFV and NFV between both groups. The distribution of ocular parameters categories is shown in Table 3.

DISCUSSION

The result of this study reported that, the numbers of female subjects are more than the male subjects in both groups of intermittent exotropia and control groups. This result supported by Nusz *et al* (2005) evaluated gender differences among children

Table (3). Distribution of ocular parameters categories between control and intermittent exotropia

Test	Control	Intermittent exotropia
	n (%)	n (%)
Worth-4-dot test		
Fusion	30 (63.8)	17 (36.2)
RE suppress	0 (0)	4 (10.0)
LE suppress	0 (0)	5 (10.0)
Diplopia	0 (0)	4 (10.0)
Ocular motility test (RE)		
Full	30 (51.7)	28 (48.3)
Limited	0 (0)	2 (10.0)
Ocular motility test (LE)		
Full	30 (51.7)	28 (43.3)
Limited	0 (0)	2 (10.0)

diagnosed with intermittent exotropia and found that intermittent exotropia was predominantly female[8]. Otherwise Cass (1937) reported an incidence of 70.0% females in 88 cases[13], Kreztkowa and Pajakowa (1972) reported 67.0% females of 620 patients with exodeviation[14] and Gregerson (1969) reported 61.0% females of 231 patients have exodeviation [15].

The ethnicity of the (X) T and non squint subjects, It shows that there are three races in Malaysia and the commonest race is Malay followed by Chines and Indian people. This study reported that majority with intermittent exotropia were Malay race. This result supported by the commonest race in Malaysia.

A study by Robert *et al* (2003) has studied the clinical course of intermittent exotropia [16]. This study involved the patients diagnosed with intermittent exotropia from 1983 to 1991 who had at least four years follow up. On the other hand, this study shown that by repeated the measures analysis of variance, there was no significant difference (F= 0.0002, p = 0.99) in the magnitude of changes in the exodeviation at the first and final visit of the patients who were treated at some point during the follow up[16].

The results of this study reported that spherical equivalent of the refractive error were not significantly different between intermittent exotropia and control groups for both left and right eyes. On the other hand, visual acuity at 6m both groups were statistically significant between these two groups with higher value in the intermittent exotropia group. Higher amplitude of accommodation was observed in the intermittent exotropia group compared to control group for both left and right eyes. The vergence for 6m and 40cm for prism cover test were significantly different between two groups and higher values were reported in intermittent exotropia group. The findings were in agreement with Robert *et al* (2003)[16].

The W4-dot-test of the two groups for right eye suppressing left eye suppressing and Diplopia, all patients fall under (X)T. The OMT of the two groups for both right eye and left eye the majority fall under full motility except 2 (10.0 %) subjects fall under limited motility in the (X) T.

One of the weaknesses in the study is that, the VA at distance and at near was measured by Snellen chart. The log Mar chart is very important chart for accurate measuring of the VA. Longitudinal study is recommended for Malaysian populations to monitor the intermittent exotropia in progressive case or late onset of the intermittent exotropia.

The findings concluded that female are the most common in both groups' intermittent exotropia subjects and the non squint subjects and the majority is Malay subjects. The spherical equvelent, PFV, NFV of the two groups is not significant different statistically for the right and left eye. The VA at 6m, AA, PCT, stereopsis, NPC of the two groups is significant for the right and left eye whereas VA at near (40cm) is the same of the two groups for the right and left eye. The W4-dot-test of the two groups for right eye suppressing left eye suppressing and

Diplopia, all patients fall under (X)T. The OMT of the two groups for both right eye and left eye the majority fall under full motility except 2 (10.0%) subjects fall under limited motility in the (X) T.

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