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ORIGINAL ARTICLE

Clinical features of strabismus in psychomotor retardation☆

Belina Arias-Cabello*, María Estela Arroyo-Yllanes, José Fernando Pérez-Pérez, Anselmo Fonte-Vázquez

Servicio de Oftalmología, Clínica de Estrabismo, Hospital General de México Dr. Eduardo Liceaga, Secretaria de Salud, México, D.F., Mexico

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KEYWORDS
Strabismus;
Psychomotor disorder;
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Abstract
Background: In psychomotor retardation there is an abnormal development of mental, sensory and motor skills associated with ocular manifestations. There are biological and psychosocial risk factors that predispose an individual to neurological damage. From 50% to 80% of patients with strabismus retardation have special features that differentiate it from the rest of strabismus in healthy patients.
Objective: To determine the most common type of strabismus in patients with psychomotor retardation and their clinical features.
Material and methods: Patients with psychomotor retardation and strabismus were included. An ophthalmological examination was performed, as well as an evaluation of the characteristics of strabismus, including perinatal and post-natal history.
Results: Esotropia was the most frequent squint with 65.3%, followed by exotropia with 32.7%. The variability in the squint magnitude was 60% in both types, and 6 patients had dissociated vertical deviation. Most of the patients started to present strabismus since they were born. The most frequent perinatal risk factors were threatened miscarriage, pre-eclampsia, foetal distress, and hypoxia.
Conclusions: Esotropia is the most common type of strabismus in psychomotor retardation. The variability of squint magnitude is a characteristic in these patients. The moderate variability is the most frequent in both esotropia and exotropia. The most common refractive error is hyperopic astigmatism in esotropia and the myopic kind in exotropia.

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* Corresponding author at: Eje 2A Sur (Dr. Balmis) No. 148, Cuauhtémoc, Doctores, C.P. 06726 México, D.F., Mexico. Tel.: +52 (55) 2789 2000.
E-mail address: beloca83@yahoo.com.mx (B. Arias-Cabello).

PALABRAS CLAVE
Estrabismo;
Trastornos psicomotores;
Factores de riesgo

Características clínicas del estrabismo en retraso psicomotor

Resumen
Antecedentes: En el retraso psicomotor hay desarrollo anormal de capacidades mentales, sensoriales o motoras, que se asocian con manifestaciones oculares. Existen factores de riesgo biológicos y psicosociales que predisponen a un individuo a daño neurológico. Del 50 al 80% de los pacientes con retraso psicomotor tienen estrabismo con características especiales, que lo diferencian del resto de los estrabismos en pacientes sanos.
Objetivo: Conocer el tipo más común de estrabismo en pacientes con retraso psicomotor, así como, sus características clínicas.
Material y métodos: Se incluyó a pacientes con retraso psicomotor y estrabismo. Se realizó exploración oftalmológica completa, valoración de las características del estrabismo y se indagó acerca de antecedentes perinatales y posnatales.
Resultados: La desviación más frecuente fue la endotropia con un 65.3%, seguida de la exotropia con 32.7%. La variabilidad de la magnitud de la desviación fue aproximadamente del 60% para ambos tipos de desviación; 6 pacientes presentaron desviación vertical disociada. La mayoría de los pacientes comenzaron a desviar desde el nacimiento. Como antecedente de importancia, los factores de riesgo perinatales más frecuentes fueron amenaza de aborto, preeclampsia, sufrimiento fetal y, asfixia neonatal.
Conclusiones: La endotropia es el tipo de estrabismo más frecuente en retraso psicomotor. La variabilidad de la magnitud de desviación es una característica del estrabismo en pacientes con retraso psicomotor. La variabilidad mediana es la más frecuente tanto en endotropias como en exotropias. El defecto refractivo más frecuente es el astigmatismo hipermetrópico compuesto en endotropias y miópico en exotropias.

Background

The development of the brain and that of the eye are closely related, at both a morphological and molecular level. Therefore some eye disorders are accompanied by malformations of the central nervous system.[1]

Psychomotor development is a dynamic and complex process which involves interrelated biological, psychological and social aspects, and is the basis of children's motor, intellectual, and subsequent relational skills.[2] Psychomotor retardation is the abnormal development of an individual's mental, sensory or motor skills, and an alteration in the development of their skills, with an imbalance in the integrity of the central nervous and peripheral system, which means that the achievements of a paediatric patient appear in slow sequence or qualitatively altered for their age, especially in the first years of life, considered the plastic age in general neurological function.[3]

There are several elements which can alter a child's development in the first 3 years of life.[3,4] According to Sweeney and Swanson,[5] the risk factors associated with delayed psychomotor development can be biological (prenatal, natal and postnatal), psychosocial or environmental[4,5] (Table 1).

The World Health Organisation considers that the frequency of high-risk pregnancies affects 3–5% of neonates.[6] The high neurological risk in children is a public health problem in Mexico, and currently it is estimated that 7–8% of all live newborns are born prematurely (under 37 weeks), and that 1–2% are born weighing under 1500 g[1] and these children are more likely to develop motor problems because their nervous system is immature which makes it more susceptible to injuries to the motor system which is so fragile and vulnerable. It has been observed that the larger the injured area, the greater the motor impairment, and therefore, the damage to other neurological functions.[7]

Cerebral palsy, defined as impaired control of movements and posture, is of early onset, secondary to central nervous system disease or dysfunction not resulting from progressive or degenerative brain disease. From 30% to 50% of patients with cerebral palsy have psychomotor retardation.[1] They can present sensory deficits (atrophy of the optic nerve, deafness, lack of development of the visual cortex). From 50% to 90% of patients with cerebral palsy present neurological impairment, amblyopia, refractive errors, congenital cataracts, impaired ocular mobility; the latter include strabismus, oculomotor palsy, nystagmus, gaze palsy, and other supranuclear disorders.[7]

Neurological disorders and psychomotor retardment are associated with strabismus in 50–80% of cases. The characteristics of this type of strabismus are generally similar to those of other types of strabismums in normal children, but a small percentage have differences which are sufficient to distinguish them. Children with neurological disorders, with horizontal type strabismus, have a high prevalence of constant exotropia and hyperfunction of the superior oblique muscles compared to healthy strabic children.[8] The

Table 1 Risk factors for neurological damage.

Biological risks	
• 1500 g or < 32 weeks of gestation	
• Infant of low birth weight for gestational age	
• Prenatal infection	
• Perinatal asphyxia	
• Mechanical ventilation for more than 24 h	
• Neonatal seizures	
• Postnatal sepsis, meningitis or encephalitis postnatal	
• Clinical or neuroimaging evidence of central nervous system disease which might affect development	
• Hyperbilirubinaemia which required exanguinotransfusion	
• Genetic, dysmorphic or metabolic disorders	
• Malformative syndrome with visual or hearing impairment	
• Inadequate nutrition	
Established risk	**Environmental risk**
• Hydrocephalus	• Social: single parent, adolescent
• Microcephalus	• Drug addiction, maternal alcoholism
• Chromosome abnormalities	• Ecological (lead)
• Skeletal muscle abnormalities	• Psychological (deprivation), poverty, no schooling
• Multiple births	• Parent with a major mental or emotional disorder including: drug addiction, depression and severe anxiety
• Myelodysplastic syndromes	
• Congenital myopathies and myotonic dystrophies	
• Inborn errors of metabolism	
• Brachial plexus injuries	
• HIV infections	

strabismus is usually horizontal and not paralytic. They commonly present vertical incomitance, with alphabetic syndrome ''A''. Some studies show that esotropia is the most common type, however, in other studies, exotropia dominates.

It has been demonstrated that variability is closely related to neurological instability and poor binocular vision, and that variable deviation is characteristic of patients with brain damage. Retardment is a major factor in the inadequate development of the binocular integration centres of the cortex, which is represented by the low fusion potential in these patients. This is probably one of the main causes of the high frequency of association with strabism. This variable or dyskinetic angle strabismus is very common and is characterised by ocular deviation, which goes from esotropia to exotropia; however, most are not associated with the accommodative reflex or attention.[9]

The neurological status of these patients limits surgical treatment, and because it has comorbidity factors, this option is delayed. It is postponed in order not to interfere with neurological management, in order to avoid exposing the patient to deep general anaesthesia, and due to the association with other systemic disorders. Furthermore, it is not indicated as a first option for these patients, as patients with psychomotor retardment have an uncertain prognosis due to the greater presence of recurrent or consecutive strabismus. The reason for these poor results might be associated with a basic defect of binocular vision or to general muscle tone impairment.[9]

Given the above, a study was undertaken to establish the most frequent type of strabismus and its characteristics, and establish the treatment prognosis for these types of patients.

Material and methods

A prospective, cross-sectional, descriptive and observational study was undertaken, in order to establish the type of strabismus and its characteristics in patients with psychomotor retardment, and the risk factors for developing the latter.

Patient with psychomotor retardment and strabismus of any age and sex, attending the Paediatric Ophthalmology and Strabismus clinic of the *Hospital General de México* for general consultation during the period between 15 March and 15 October 2012. Patients who were outside the enrolment range, patients with secondary strabismus and those who did not cooperate on strabological examination were excluded from the study.

The following variables were analysed: age, gender, perinatal history divided into (*a*) prenatal (conception period [18–35]), course of pregnancy, perinatal control, vaginal or urinary tract infections; (*b*) natal: method of delivery, foetal distress, neonatal asphyxia, need for mechanical ventilation, hyperbilirubinaemia, gestational age and, birth weight; and (*c*) postnatal: seizures, meningitis, cranioencephalic trauma, and hydrocephalus. A full ophthalmological examination was performed. The following were analysed as strabological variables: type of strabismus (esotropia, exotropia), presence or otherwise of associated dissociated strabismus, presence or otherwise of vertical muscle hyperfunction, measurement of variability of deviation magnitude, and associated refractive defect.

The data obtained were analysed by means of descriptive statistics, measured in percentages to evaluate frequencies.

Results

There were 49 patients with psychomotor retardment and strabismus, 53.1% ($n = 26$) were female and 46.9% ($n = 23$) male. Of the patients captured, 8 were placed in the age range newborn to one year of age, 30 were aged over one up to the age of 10, 10 were aged over 10 up to the age of 17, and there was only one adult patient.

From the age of 18–35 was considered an appropriate conception period, pregnancies in women under or over this age being considered as high risk. It was found that 28.6% ($n = 14$) of the mothers were adolescents; most of the mothers, 53.1% ($n = 26$), had their children in an appropriate conception period, and 18.3% ($n = 9$) had them over the age of 35. The number of pregnancies of each patient was investigated and it was found that 20 patients were primigravida, 23 were multiparous, and only 6 were highly multiparous (having had 5 or more births).

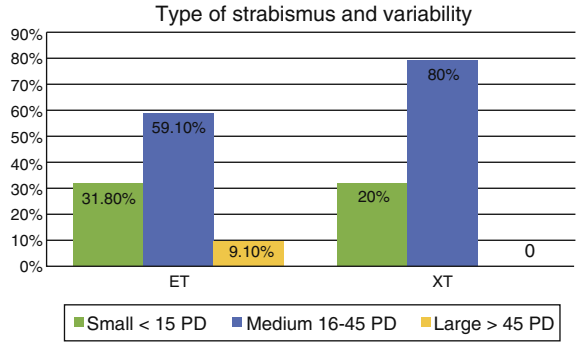

Figure 1 Estrabismus and variability.
PD: prismatic diopters; ET: esotropia; XT: exotropia.

The most frequent deviation found was esotropia in 65.3% ($n = 32$), followed by exotropia at 32.7% ($n = 16$), and only 2% ($n = 1$) presented nystagmus with no deviation towards the forehead. Of the patients with esotropia, 22 (68.75%) presented a variation in the magnitude of deviation, which varied from small (< 15 prismatic diopters [PD]) 31.8%, medium (16–45 PD) 59.1%, and large endotrophies (> 45 PD) 9.1%. It was found that 62.5% ($n = 10$) of the exotrophies had variability, small in 20%, and medium in 80% (Fig. 1). Only 4 patients with esotropia, and only 2 of the patients with exotropia presented dissociated vertical deviation. Another 3 patients had esotropia with inferior oblique muscle hyperfunction, of the 4 patients with exotropia, 2 had hyperfunction of both inferior oblique muscles and one of the superior oblique muscle. The mothers reported that 63% ($n = 31$) started to deviate from birth, 22.45% ($n = 11$) from 3 months to one year old, and 14.3% ($n = 7$) over the age of one. The type of refractive defect was investigated (Fig. 2) for each type of deviation. The positive sphere range was +0.25 to +8.00, negative sphere from −1.00 to −3.00, and cylinder from −0.50 to −6.00.

The following risk factors reported in the sample were as follows: with regard to gestational age, 55.1% ($n = 27$) were delivered at term, 40.8% ($n = 20$) were premature, and 4.1% post-term. The perinatal history was divided as follows: (*A*) prenatal: where it was found that 34.7% ($n = 17$) of the mothers presented urinary tract or vaginal

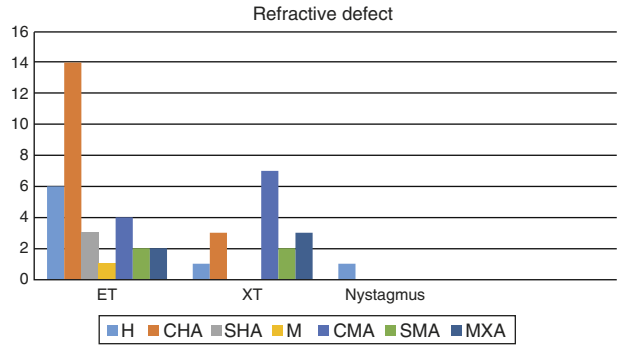

Figure 2 Refractive defect and type of strabismus
ET: esotropia; XT: exotropia; H: hypermetropia; CHA: compound hypermetropic astigmatism; SHA: simple hypermetropic astigmatism; M: myopia; CMA: compound myopic astigmatism; SMA: simple myopic astigmatism; MXA: mixed astigmatism.

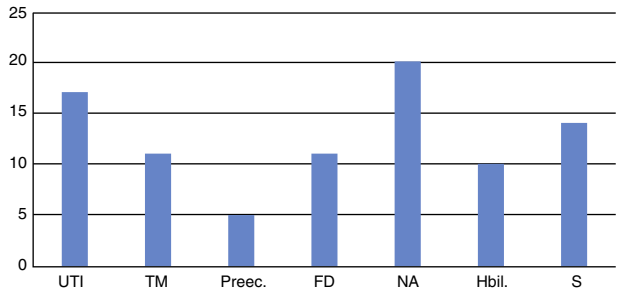

Figure 3 Perinatal risk factors (prenatal, natal, postnatal).
UTI: urinary tract infection; TM: threatened miscarriage; Preec: pre-eclampsia; FD: foetal distress; NA: neonatal asphyxia; Hbil: hyperbilirubinaemia; S: seizures.

infection, 22.4% ($n = 11$) threatened miscarriage, 10.2% ($n = 5$) pre-eclampsia, and the remaining 32.4% did not specify the cause of their ''abnormal'' pregnancy. (*B*) Natal history: 22.4% ($n = 11$) had foetal distress, 40.8% ($n = 20$) neonatal asphyxia, 20.4% ($n = 10$) hyperbilirubinaemia, the remaining 16.4% of mothers did not know the birth conditions. And finally, (*C*) postnatal history: where 28.5% (14 patients) presented seizures, these were patients with exotropia in the majority (Fig. 3).

Discussion

The reason for undertaking this study was to better establish the characteristics of strabismus which presents in children with psychomotor retardment, and thus establish a prognosis and find the most appropriate treatment for these patients. Understanding the development of the child from any area: cognitive, affective, motor or social, invariably brings us to its beginnings. Therefore, many studies have made it their objective to search for relationships between diseases of the newborn infant and their sequelae.[10]

There is no difference between genders in this study; the percentage was similar in females (54.5%), and males (45.5%). In terms of age range, most of the patients studied were aged between one and 10, and this was probably due to the age of diagnosis or confirmation of the psychomotor retardment or the neurological impairment, which was diagnosed in the majority over the age of one, this being the time that paediatricians undertake a full assessment, and then refer the patient to the appropriate department according to the problem that needs to be treated.

Esotropia was the most common type of strabismus at 65.3%, in the study sample, and the remaining 32.7% had exotropia. As mentioned in other studies, variability in magnitude of deviation is characteristic of strabismus in psychomotor retardment, especially esotropia. Variation is 10 PD or more from one moment to the next and can last from seconds to days. In general there is no alteration of the ductions, which is consistent with the study; 100% of the patients had no limitation of movement. From 50% to 80% of strabismus are related to psychomotor retardation; it is believed that 35% present variability, and that 50% of this variability corresponds to variable

angle esotropia.[11] According to Díaz et al.,[11] variability of medium magnitude (16–45 PD) is more common. Here variabilities of esotropia were analysed, medium esotropia presented in 70.45%, followed by small, and finally large esotropia. In our study similar results were obtained with a medium variable in 59.1%, small in 31.8% and large in 9–1%.

Brodsky[8] mentions that children with neurological damage have a higher incidence of constant exotropia with superior oblique muscle hyperfunction, compared with strabic children without neurological damage. In this study a different percentage was encountered, as 62.5% of the exotropias presented variability, medium exotropia being the most common in 80%, and small in 20%. With regard to vertical muscle hyperfunction, only 2 patients had hyperfunction of the superior oblique muscles and 2 of the inferior oblique muscles, and therefore this is not a significant percentage.

With regard to refractive defects in these patients, in line with other authors, most had a tendency towards hypermetropia, the maximum sphere being +8.00 in one patient; in addition to hypermetropia, the relationship with stigmatism was also significant: it was found that the most negative cylinder was −4.00. It is important to mention that in the esotropias compound hypermetropic astigmatism presented more frequently, whereas this was compound myopic astigmatism in the exotropias.[12,13]

It is mentioned that parity is associated with toxaemia or pre-eclampsia in pregnancy. Primiparous women are at most risk, 4–5 times higher than multiparous women. This data was corroborated in the study since 25% of the primigravidas (20 mothers) had pre-eclampsia; in this sample none of the multiparous women had pre-eclampsia.[14] The percentage of mothers of the appropriate age for conception and giving birth (18–35) was 53.1%, followed by adolescent mothers (< 18) at 28.6%. This data draws attention as in previous studies it has been found that adolescent mothers are more at risk of difficult labours, premature births, and foetal distress.[15]

Sánchez et al.[1] performed a study with 307 patients and found that the main causes of neurological damage, in descending order were: neonatal asphyxia (53.7%), hyperbilirubinaemia (22.14%), foetal distress (18.24%), threatened miscarriage (11.7%), urinary tract infection (11.4%) and pre-eclampsia (9.7%). However in our study we only agree that neonatal asphyxia is the most common cause at 40.8%, followed by urinary tract infection at 34.7%, seizures 28.5%, foetal distress 22.4%, hyperbilirubinaemia 20.4%, and finally pre-eclampsia at 10.2%. Foetal distress encompasses perinatal asphyxia, which develops in utero, and neonatal asphyxia, which presents at birth, and is confirmed by metabolic alterations. It is one of the main causes of perinatal morbimortality with a frequency of 1.6–5.3 per hundred live newborns. The incidence of this condition varies with the gestational age, at 0.5% in infants born at term which contrasts with the 50% in infants born after less than 30 weeks gestation. However, in our sample there was no difference between the gestational ages.[1] In their review, Castellanos et al.,[6] mention that around 4 in every 10 (43%) infants with a history of neurological risk, even if they had perinatal asphyxia, might have a neurological injury; 28% of our sample did not have a history of risk.[6]

Conclusions

- Esotropia is the most common type of strabismus in psychomotor retardation.
- Variability of the magnitude of deviation is a characteristic of strabismus in patients with psychomotor retardation.
- Medium variability is the most frequent both in esotropias and in exotropias.
- The most common refractive defect is compound hypermetropic astigmatism in esotropias and myopic in exotropias.

Conflict of interests

The authors have no conflict of interests to declare.

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