Dissociated deviation in sensorial strabismus

Desviación disociada en estrabismo sensorial

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Abstract

Purpose: The aim of this study was to determine the relation between dissociated deviations in patients with sensorial strabismus. Methodology: It was a prospective, transversal, and descriptive observational study. It was included all the patients with the diagnosis of sensorial strabismus of the strabismus service; a complete ophthalmological examination was performed including searching for dissociated deviation with monocular occlusion and Posner maneuver. The statistical analysis was descriptive, averages were used for quantitative variables and Fisher’s exact test; for qualitative variables, percentages and simple frequencies were used. Results: There were in total 60 patients, with dissociated deviation were 19, of those 16 had the injury since birth. Of the 41 patients without dissociated deviation, 24 had the injury since birth. The analysis of the presence of dissociated deviation and early injury was p = 0.03. Conclusions: There is a relationship between the presence of dissociated deviation and the ocular injury that occurs at an early age in sensory strabismus.

Key words: Dissociated deviation. Sensory strabismus. Poor vision. Earlier injury. Exotropia. Esotropia.

Resumen

Objetivo: Determinar la relación entre desviación disociada en pacientes con estrabismo sensorial y el momento en que se produce la lesión. Metodología: Se realizó un estudio prospectivo, transversal, descriptivo y observacional. Se incluyó a todos los pacientes con diagnóstico de estrabismo sensorial de la consulta externa de estrabismo, se les realizó una exploración oftalmológica completa y estrabológica, se buscó desviación disociada por medio de oclusión monocular y maniobra de Posner. El análisis estadístico fue descriptivo; para variables cuantitativas se utilizaron promedios como medidas de tendencia central y la prueba exacta de Fisher; para las variables cualitativas se utilizaron porcentajes y frecuencias simples. Resultados: Fueron un total de 60 pacientes. Presentaron desviación disociada 19, de los cuales 16 tenían la lesión desde el nacimiento. De los 41 sin desviación disociada, 24 presentaron la lesión desde el nacimiento. El análisis de la presencia de desviación disociada y lesión temprana fue de p = 0.03. Conclusiones: Existe una relación entre la presencia de desviación disociada y la lesión ocular que se produce a edad temprana en los estrabismos sensoriales.


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Introduction

Sensory strabismus

Secondary or sensory strabismus occurs due to a significant decrease in vision secondary to anatomical alterations or anisometropia. The main feature is monocular deviation of the eye with poor vision\textsuperscript{3,7}.

The frequency of sensory strabismus ranges from 6 to 8.94\% depending on the study, and exotropia (XT) is more frequent than esotropia (ET). According to the age of onset, the direction of the deviation differs: between 0 and 1 years ET 46\% and XT 54\%; from 1 to 5 years ET 26\% and XT 74\%; from 6 to 10 years ET 5\% and XT 95\%; and from 11 years onward ET 16\% and XT 84\%\textsuperscript{5}.

There are several theories about its etiopathogenesis, but all of them agree that it is a consequence of the lack of image or light capture in one eye. Chavasse says that the deviation is the result of the influence of convergence according to the age at which it occurs. Bielschowsky points out that when the eyes are binocularly dissociated due to angulation of the orbit, the following would occur: before 15 years of age less divergence would cause ET, and after 15 years of age greater divergence would cause XT. Jampolsky points out that the existence of luminous perception favors in greater proportion the deviation and if the perception is completely abolished, the deviation is smaller. Arroyo-Yllanes mentions that the eye with poor vision develops ET instead of XT due to uncorrected hyperopia; if the eye is hyperopic, the effort of accommodation triggers accommodative convergence that is transmitted to the eye with poor vision, causing ET\textsuperscript{5,7}.

The diagnosis is made by a complete ophthalmological examination, which will reveal the cause of poor vision and the type and magnitude of the existing deviation\textsuperscript{3,5}.

Surgical treatment aims to correct the deviation; the technique will depend on each case. Conventional surgery or innervational surgery can be performed for each type of deviation\textsuperscript{3,5,7-9}.

Dissociated deviation

Dissociated deviation is a bilateral phenomenon, asymmetric, in which there is, in the following order, a movement of elevation, excyclotorsion, and abduction when occluding one eye, and a recovery movement of adduction, incyclotorsion, and depression when the eye is unoccluded. The magnitude of the movement is almost always more evident when the non-fixating eye is occluded, one eye is independent of the other to perform the movement and Hering’s law is not respected.

According to the predominant movement, dissociated deviation is classified as dissociated vertical deviation (DVD) when it is a vertical movement, horizontal dissociated deviation when it is a horizontal movement, and dissociated torsional deviation when it is a torsional movement.

DVD is the most common of the three types. It occurs in very early onset strabismus and with sensorial damage, so it is mainly associated with congenital ET, latent nystagmus and non-fusing intermittent XT.

Regarding its etiology, it is not known with certainty; there are several theories but none of them has been proven. It is known that DVD is a bilateral phenomenon of central origin, involving vertical action muscles.

Despite being bilateral, it is asymmetrical and manifests more in the amblyopic eye or in the eye with worse vision. It can occur spontaneously (decompensated) or not spontaneously (compensated). Since dissociated deviation presents a lot of variability in the magnitude of the deviation, a qualitative and useful way to evaluate it is by monocular occlusion at distance and following the scale: 1+ corresponds to a deviation of approximately 5 prism diopters (PD), 2+ to a deviation of 10 PD, 3+ to a deviation of 15 PD, and 4+ to a deviation greater than 20 PD.

It can be associated with hyperfunction of inferior obliques (22\%), superior obliques (11\%), and both (9\%); and it is observed more commonly in the affected eye.

It is more evident with reduced illumination, fatigue or with inattention and distant fixation. To demonstrate it, the monocular occlusion maneuver or Posner’s test can be used; in some cases, it is necessary to neutralize the existing deviation first. Bielschowsky’s maneuver may also be performed or Bielschowsky’s phenomenon may occur; however, these are not present in all cases.

The treatment is surgical, and it is indicated in spontaneous cases. Depending on the characteristics of the DVD, the existing deviation and the hyperfunction of the associated vertical action muscles, a surgical or other technique will be chosen (retro-insertion of superior rectus muscles, anterior transposition of the inferior obliques, or reinforcement of the inferior obliques)\textsuperscript{1}.

When residual DVD remains after surgery, a 1\% atropine penalty has been used in the fixing eye, which decreases the magnitude and phases of decompensation\textsuperscript{10}.
Since sensory strabismus causes loss of fusion due to poor monocular vision and some types occur at an early age, this study was designed to define the presence of dissociated deviation and to estimate if it is more frequent if the injury has occurred at an early age.

**Purpose**

**General purpose**

To determine the timing when dissociated deviation in sensory strabismus occurs in patients of the external consultation of strabismus in the Hospital General de Mexico Dr. Eduardo Liceaga, attended from October 2014 to November 2015.

**Specific purposes**

- Identify the most common type of dissociated deviation.
- Identify the causes of sensory strabismus.
- Identify the frequency of the direction of the deviation in sensory strabismus.

**Materials and methods**

This is a prospective, cross-sectional, descriptive, and observational study.

The study universe was the patients of the strabismus consultation at the Hospital General de México from October 2014 to November 2015. The study population was the patients with sensory strabismus of the strabismus consultation in the Hospital General de México from October 2014 to November 2015.

All patients diagnosed with sensory strabismus were included, regardless of age, sex, and without previous corrective treatment for strabismus. Those who had another type of strabismus and those who did not cooperate for the exploration or had an incomplete medical file were excluded.

The variables studied were dissociated deviation, sensory strabismus, visual acuity, age, and sex.

All patients underwent a complete ophthalmological examination, visual acuity was taken from each eye, and refraction was performed with cycloplexy, anterior and posterior segment examination, as well as strabismus exploration, looking for dissociated deviation by means of monocular occlusion and Posner’s test.

All data were collected in the file, strabismus sheets and a database; in this database, it was stated whether the injury that caused the sensory strabismus occurred at or after birth and in which cases the patient presented any type of dissociated deviation. The following were defined:

- Birth injury, also called congenital lesion, which is structural or functional abnormalities that occur during intrauterine life and are detected during pregnancy, at birth or later.
- Injury after birth, also known as acquired injury, occurs after birth as a result of diseases, infections, and trauma, among others.

Finally, the data were analyzed. A descriptive statistical analysis was performed; for quantitative variables, averages and Fisher’s exact test were used as measures of central tendency; and for qualitative variables, percentage and simple frequencies were used.

**Results**

We obtained 60 patients, from 1 to 42 years of age (mean of 6.5 years), 40 female and 20 male.

Overall, 19 patients had dissociated deviation, 16 female and 3 male, with an age range of 2-24 years. A total of 41 patients did not present dissociated deviation (24 female and 17 male) with an age range of 1-42 years.

Regarding the direction of the dissociated deviation, in 18 cases it was vertical and in one case it was horizontal. Of them, 15 were slow and 4 were fast; 9 spontaneous and 10 non-spontaneous. The magnitude in the fixing eye was 0.5+ in 15 cases and 1+ in 4; in the non-fixing eye it was 1+ in 7 cases, 2+ in 10 cases, and 3+ in 2 cases. All scored positive on Posner’s test.

Figure 1 shows the direction of the deviation when comparing patients with or without dissociated deviation.

Table 1 summarizes the causes and timing of the injury (at birth or after birth) in patients with and without dissociated deviation.

Moreover, Figure 2 compares the presence of birth injury in patients with and without dissociated deviation.

The analysis with Fisher’s exact test for the relationship between the presence of dissociated deviation and the lesion at birth was 0.0350, statistically significant.

**Discussion**

The causes of sensory strabismus can be very diverse, and vary according to age. Among the main causes of poor vision found in our group of patients, in order of frequency, were the following: Congenital cataract,
ocular trauma, anisometropia, retinal detachment, leukoma, optic atrophy, coloboma, keratoconus, optic nerve hypoplasia, sequelae of retinopathy of prematurity, microphthalmos, ptosis, mesodermal dysgenesis, primary hyperplastic vitreous, and osteoma. The main causes in the patients of our study are consistent with those reported in the article by Riancho-Sánchez et al., except for ocular trauma, which was one of the main causes in this work.

Regarding the direction of the deviation, the most frequent type of deviation in our patients was XT, which agrees with the data published by Romero and Apis and Riancho-Sánchez et al. The age range in which XT occurred was more frequent at birth and to a lesser extent, but consistently, up to 41 years, which differs from the series of Romero and Apis, who reports a greater frequency from 6 years onward. In the case of ET, in our series, it presented more frequently from 1 to 5 years followed by those older than 11 years, which differs from the series of Romero and Apis, who reported the biggest frequency in children under 1 year of age, followed by the group from 1 to 5 years.

The presence of vertical deviations alone or associated with a horizontal deviation occurred in unique cases, except for the XT associated with hypertropia (HT), observed in 2 cases. Vertical deviations and their associations were not reported in any other study.
Regarding dissociated deviation, it presented in 32% (19 cases) of patients, from which 58% (11 cases) had XT and 37% (7 cases) ET. These results differ greatly from those reported by Riancho-Sánchez et al. in their study, where 4% of patients presented dissociated deviation, of which 3% (2 cases) had XT and 11% (2 cases) ET, 86% had no dissociated deviation and their reported age ranges were from 2 to 51 years, very similar to our data (1-42 years of age).

Comparing the presence of birth injury in patients with and without dissociated deviation, of the patients who presented dissociated deviation, the majority, except three with anisometropia, presented the lesion from birth; on the other hand, among patients without dissociated deviation, just over half had it at birth. When applying the Fisher’s test in this proportion, the value obtained for the relationship between the presence of dissociated deviation and the early lesion shows that there is a strong association between them.

This is probably related to the etiology of the dissociated deviation. Although to date, it has not been clearly established, there are several theories that propose innervational alterations at a central level, such as the theories of Bielschowsky, Prieto-Díaz and Souza-Dias and Helveston; others that state the presence of primitive reflexes due to an anomaly in evolved reflections (Crone, Ringland Anderson, Posner, and Brodsky theories); and an additional theory that refers to anatomical alterations that produce peripheral innervation phenomena, proposed by Verhoeff. Although none of these has been corroborated, they all propose that there is damage to the central or peripheral nervous system, which may be present from birth or in the early stages of life when the nervous system and binocular vision are still developing. Although the presence of dissociated deviation from birth has not been demonstrated in all patients, in most cases, it is due to difficulty at the time of exploration.

This leads us to think that the presence of dissociated deviation in our group of patients with sensory strabismus depends on how close to birth the lesion occurred. It is related to what was reported in the study by Pérez Pérez et al., who found a higher prevalence of DVD in congenital strabismus associated with amblyopia compared to patients with sensory strabismus (91% vs. 21%), since patients with sensory strabismus had a normal sensorial status before suffering the organic lesion that caused poor vision. Thus, this further reinforces the relationship between the presence of dissociated deviation and lesions at birth, which is seen in congenital strabismus with concurrent DVD, as is the case of congenital ET.

Conclusions

The main causes of sensory strabismus in this study are congenital cataract, ocular trauma, and anisometropia. XT is the type of deviation that occurred most frequently in all ages.

Dissociated deviation was present in 32%.

There is a statistically significant relationship between ocular injury with poor vision at an early age onset and the presence of dissociated deviation.

Ethical responsibilities

Protection of human or animal subjects. The authors declare that no experiments have been conducted in humans or animals for this research.

Data confidentiality. The authors declare that no patient data appear in this article.

Privacy rights and informed consent. The authors declare that no patient data appear in this article.

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Conflicts of interest

The authors declare no conflicts of interest.

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