

## Dissociated Vertical Deviation (DVD) Treated with Inhibitory Surgery in Children with Neurological Damage. Presentation of 3 Cases

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### Abstract

**Introduction:** Dissociated Vertical Deviation (DVD) is part of the dissociated strabismus group, with a cortical origin and related to epileptic diseases. The surgical techniques described for its treatment focus on the limitation of elevation by different mechanisms. Inhibition surgery limits elevation through the Sherrington Law and the control system from the cortical areas.

**Case Description:** In this paper, 3 male patients between ages 9 and 10 years are described with a brain injury detected by computerized axial tomography scan, secondary cerebral palsy and a history of perinatal asphyxia, spontaneous DVD of 2 to 4 crosses, with asymmetric elevation which underwent bilateral symmetric recessions of 6 mm in the inferior recti muscles, and the cases were associated with an exotropia that was treated with recessions of both lateral recti.

Important improvement was noticed for the vertical strabismus down to one cross or less since day one post-op and still remains after two years of follow up.

**Discussion:** Inhibition surgery is effective in limiting elevation as a treatment for DVD in children with neurological damage and poor fusion potential. Hence, we believe that an inhibitory effect is triggered from the system that controls ocular movements at the cortex.

**Keywords:** *Dissociated Vertical Deviation (DVD); Strabismus; Epileptic Diseases*

### Introduction

Dissociated Vertical Deviation (DVD) is part of the dissociated strabismus group, with a cortical origin and related to epileptic diseases. The surgical techniques described for its treatment focus on the limitation of elevation by different mechanisms. Inhibition surgery limits elevation through the Sherrington Law and the control system from the cortical areas.

### Case 1

10-year-old male, obtained from 40 weeks of gestational age with a history of perinatal asphyxiation, severe secondary spastic quadriplegia, leuco encephalomalacia in caudate nuclei and semi oval centers, left/right exotropia from birth, with insufficiency of right convergence, wears lenses to correct mixed astigmatism from the age of 3 years, vertical strabismus is added at the age of 4 years, compatible with major asymmetric DVD in the left eye, anterior segment and posterior pole without alterations, subjected to application of type A botulinum toxin for horizontal strabismus at the age of 4 years without improvement, received surgery for strabismus at the age of 10 years using the technique of elevation inhibition with excellent results for vertical strabismus (see photos of patient 1 and table).

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Preoperative patient 1: exotropia of 16 pd. ++ left hypertropia.



Patient 1 first postoperative day: exotropia of 2 pd.  
Surgery performed: 6 mm recession of both inferior recti muscles.  
4 mm recession of the left lateral rectus.

Figure 1

Patient	Strabological Diagnosis	Exotropia (pd) preop.	Major hypertropia (pd) preop.	(pd) postop.	Spherical equivalent	Other ophthalmic Dx	Other ophthalmic Dx VA CC
1	DVD + exotropia	16	10 (++)	Exotropia 2 pd.	OD: 0.00 OI: + 0.12	Mixed astigmatism	OD: 20/100 OI: 20/150
2	DVD + exotropia	30	15 (+++)	Orthotropy	OD: -0.25 OI: -0.25	Hyperopic astigmatism Hypoplasia of optic papillae	Set and follow, get attention and lose it soon
3	DVD + exotropia	14	15 (+++)	Hipertropia 5 (+)	OD: -5.50 OI: -5.50	Myopic Astigmatism sequelae of retinopathy of prematurity treated with photo	OD: 20/30 OI: 20/30

**Table:** Ophthalmological characteristics of pre and postoperative patients.

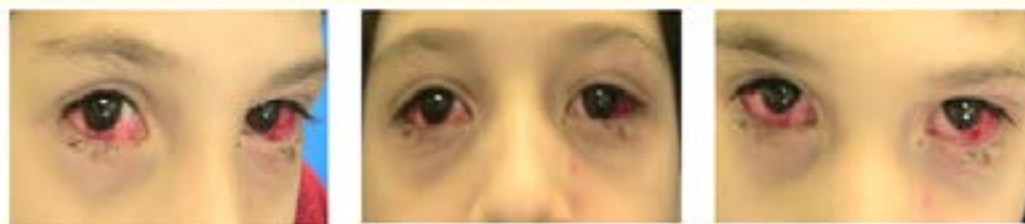
*Pd.: prismatic diopters, pre-op: preoperative, post-op: postoperative, VA CC: visual acuity with correction.*

**Case 2**

A 9-year-old male, obtained from 32 weeks of gestational age with a history of fetal distress and perinatal asphyxia, diagnosis of severe secondary flaccid quadriplegia and gelastic seizures with good control, left frontal pachygyria and both cortical and subcortical atrophy associated with severe mental retardation, presented exotropia from the age of 9 months and asymmetric DVD at the age of 6 years, more evident in the left eye, hypoplasia of both optic nerves, normal anterior segment, underwent two applications of type A botulinum toxin for horizontal strabismus without improvement, and at the age of 9 years strabismus surgery is decided under the aforementioned technique with excellent results (see photos of patient 2 and table).



*Patient 2 preoperative: Exotropia of 30 pd. double hypertrophy +++.*



*Patient 2: First day post-op, orthotropia.  
Surgery performed: 6 mm recession of both inferior recti.  
6 mm recession of both lateral recti.*

**Figure 2**

**Case 3**

A 9-year-old male, a twin pregnancy product, obtained from 32 weeks of gestational age, with a diagnosis of moderate spastic diparesis secondary to hypoxic-ischemic encephalopathy, cortico-subcortical atrophy, developed retinopathy of prematurity which required laser treatment at the age of 2 months with good evolution, wears myopia lenses from the age of 1 year, and showed exotropia from the age of 5 months with evolution to decompensation of up to 30 prismatic diopters (pd), at the age of 2 years asymmetric DVD of three crosses for the left eye was presented, more evidently than on the right eye, was submitted for strabismus surgery at the age 9 years for vertical and horizontal strabismus simultaneously (see photos of patient 3 and table).

**Discussion**

The Dissociated Vertical Deviation (DVD) was first described in 1895 as a bilateral and asymmetrical eye movement of elevation, abduction and extorsion that does not obey Hering's Law [1].



*Patient 3: First day post-op, hypertropia + at cover uncover test.  
Surgery performed: 6 mm recession of both inferior recti.  
6 mm recession of both lateral recti.*

**Figure 3**

In Mexico, it is estimated that 66.3% of children with cerebral palsy (CP) have strabismus and other alterations which can result in poor vision and amblyopia at an early age, contributing to the appearance of DVD due to interruption of early binocular development and alteration in fusion [2,3]. The risk of strabismus when there is associated neuronal damage is high if we consider that eye movements are regulated by an integrative system from cortical areas to the brain stem, whose efficiency allows eye movements to be under supranuclear control and Hering's Law [4,5]. Cortical, metabolic and structural alterations have been found in DVD, leading to a decrease in the integrator's ability to modulate and/or effectively inhibit, which is reflected in the malfunction of the brain's inhibitor-exciter system.

Gallegos-Duarte has studied DVD through digitalized brain mapping, capturing the cortical bioelectric response and a simultaneous recording of eye movements by electro oculography and video filming. Here it is shown that the cerebral cortex actively participates in the production of dissociated movements, reason for which it has been considered a strabismus of cortical origin [6,7].

There are many surgical techniques described for the treatment of DVD, the most commonly used and well known are: Wide and symmetrical recession of the upper rectum, indicated for DVD that is not associated with hyperfunction of lower obliques described by Jampolsky [8]. Anterior transposition of the lower obliques with or without hyperfunction, indicated for large DVD, described by Elliot and Nankin [9]. Reinforcing techniques refer to resections of the lower recti, folds of the upper obliques or combinations. It is claimed that surgery for DVD is intended for elevation limitation. In 2013, Romero Apis proposed for the first time the wide and symmetrical 6 mm recession of both lower recti as an innervation technique, seeking to inhibit the action of the upper rectum and, consequently, the elevation based on Sherrington's law under the following rationale: The recession of both lower recti induces a relative hypertropia that the patient has to compensate by increasing the innervation load on the inferior rectus, so that by Sherrington's law, when contracting the inferior recti an inhibitional load of the same magnitude is sent to the upper rectum, thereby reducing dissociated hypertropia [10].

We consider that in addition to the failure of peripheral innervation that governs eye movements there is the bioelectric alteration of the cerebral cortex that triggers the dissociated movements of the DVD, so that Sherrington's law of inhibition of elevation can result in better anti-lifting effect and therefore better post-surgical results in patients with neurological damage since it represents a way of counteracting the predominance of the exciting component over the inhibitor in the system of control of ocular movements from the cerebral cortex, which is why it has been decided to report these cases of children with brain injury and DVD who have been operated with this technique.

## **Conclusion**

Inhibition surgery is effective in limiting elevation as a treatment for DVD in children with neurological damage and poor fusion potential. Hence, we believe that an inhibitory effect is triggered from the system that controls ocular movements at the cortex.

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