Sriwijaya Journal of Ophthalmology
Journal Homepage: https://sriwijayaopthalmology.com/index.php/sjo

Stereoscopy, Brown Syndrome, and Duane Syndrome: A Literature Review

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ARTICLE INFO

Keywords:
Stereoscopy
Brown syndrome
Duane syndrome

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The author has reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/sjo.v5i2.79

A B S T R A C T

Stereoscopic is the ability to perceive visual objects in the depth dimension (in the third dimension). Having a stereoscopic vision is a goal to be achieved. Brown Syndrome is a rare form of strabismus in which an ocular motility disorder is characterized by restriction of the elevation of the adducted eye, whereas Duane Syndrome is a spectrum of eye motility disorders characterized by anomalous contractions of the medial and lateral rectus muscles in actual or attempted adduction of one or both eyes. Involved. Diagnosis and therapy are performed depending on the underlying condition of the disorder.

1. Introduction

Stereoscopy or stereopsis occurs when the last 2 images of an object in front or behind the plane of fixation which has minor differences due to the horizontal separation of the eyes are cortically integrated, resulting in the perception of relative depth.[1] In other words, stereoscopy is the ability to perceive visual objects at a distance, the depth dimension (the third dimension), which occurs when horizontally different retinal images are stimulated simultaneously.[2,3]

Having a stereoscopic vision is a goal to be achieved. Perfect stereoscopic or stereopsis will help precise and accurate hand movements. Both children and adults with stereoscopic dysfunction will perform poorly on some visuomotor activities compared to their counterparts with normal stereo acuity.[4,5]

Brown Syndrome is a rare form of strabismus in which ocular motility is impaired, characterized by restriction of adducting eye elevation. It is the most common cause of isolated paralysis of the inferior oblique muscle, one of the extraocular muscles responsible for ocular motility.[6-8]

Duane Syndrome or Duane Retraction Syndrome is a spectrum of ocular motility disorders characterized by anomalous contractions of the medial and lateral rectus muscle in actual or attempted adduction of one or both the involved eyes; this co-contraction causes the eyeball to recoil.[1,9-10]

Stereoscopy

Stereoscopy is the ability to perceive visual objects at a distance, the depth dimension (the third dimension), which occurs when horizontally different retinal images are stimulated simultaneously.[2,3]

The mechanism of stereoscopic/stereopsis occurs in that the object we see falls on two retinas, which have a slight difference due to the horizontal distance between the left eye and right eye, thus integrating cortically and forming depth perception. After two eyes can see the image separately, the brain then combines the resulting images, which is called the fusion process. The next process is analysis. The brain then analyzes the object in the image in one eye and compares it to the other. By observing subtle differences in the two images generated based on the distance between our eyes, the brain creates a 3D perception in the visual cortex.[4,11]

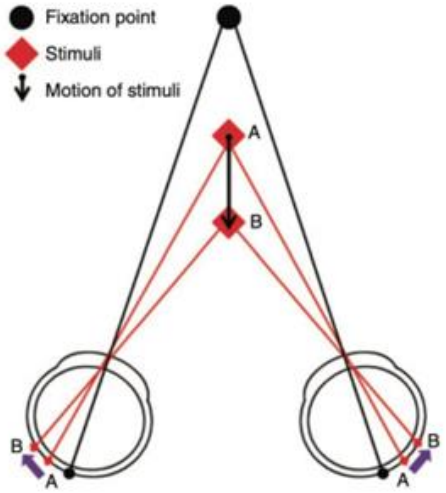

Figure 1. The distance between the two eyes causes retinal disparity.[4]

All stereoscopic examinations are based on one of three principles. Technically, a haploscope is an optical device used to deliver different images simultaneously to each eye. The principle of the Anaglyph technique is to use different colors to present different images. Lastly, the principle of the Vectograph centers on the fact that light waves can be polarized.[4,12]

There are two kinds of stereoscopic tests, namely qualitative and quantitative tests. The horizontal Lang Two Pencil Test is a simple qualitative test with high sensitivity. This test can be used as a screening tool to find global stereopsis and binocularity. The synoptophore, also known as the primary amblyoscope, is a multipurpose instrument that can be used to subjectively assess ocular motility for a quantitative test in the form of the Contour Stereopsis Test, where the type of test that is widely used is the Titmus stereopsis test. The TNO stereo test is a common test used to evaluate stereoscopic vision where the patient needs to wear anaglyph glasses.[4,12]

The total absence of stereoscopic vision is called stereo-blindness, and partial dysfunction has several names: stereo-impairment, stereo anomaly, or stereo deficiency. Stereo-blindness is the inability to see 3D shapes using stereoscopic vision, which makes them unable to perceive stereoscopic depth by combining and comparing an object from both eyes.[4,13]

The prevalence of stereo-blindness in the general population ranges from 1% to 64%. Adrien Chopin (2019) estimates the prevalence of stereo-blindness to be 7%.6 The cause of stereo-blindness in strabismus is a central process, at least in some cases.4 In addition, stereopsis is often inhibited in patients with

age-related macular degeneration (AMD). The decrease in stereo acuity is also influenced by age. Stereoacuity is decreased in patients with cataracts and glaucoma.[4,14]

Brown syndrome

Brown Syndrome is a rare form of strabismus in which ocular motility is impaired, characterized by restriction of adducting eye elevation.[6-8]

Most cases are unilateral, whereas only 10% of congenital cases are bilateral. The condition is most commonly seen in childhood: the congenital form is diagnosed around a mean age of 5 years (4–21 years) to 6 years (1–13 years), and the diagnosis of the inflammatory form is later, with a mean age of 43 ± 18 years. This syndrome shows a moderate predominance in women in the congenital form (52.6% to 59.1%) but is more prominent (86%) in the case of the inflammatory form.[15-16]

The well-known clinical features of Brown's syndrome include a deficiency of elevation in adduction that improves on abduction but is often not complete. Several findings distinguish Brown's syndrome from inferior oblique muscle paralysis. A strongly positive forced duction test indicates limited passive elevation and is important for diagnosis. Virtual ball retropulsion during this test stretches the superior oblique tendon and accentuates the restriction. In constraints involving the inferior rectus muscle or surrounding tissue, in contrast, the limitation of passive elevation is accentuated by forceps-induced proptosis of the eye rather than by retropulsion.[1,17]

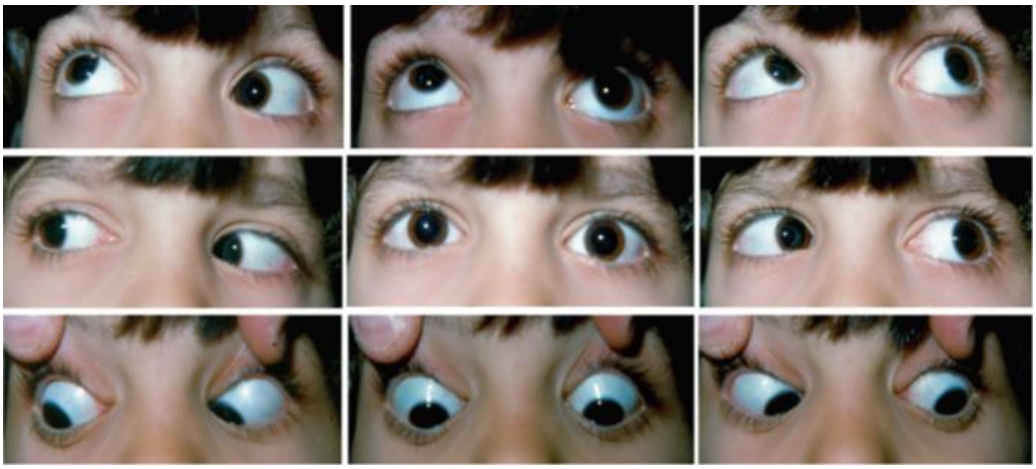

Figure 2. Brown's syndrome, left eye. No elevation of the left eye on adduction; the left eye is depressed. The elevation is also very limited in straight-up gaze and quite limited even in up and left gaze. Note the characteristic difference in straight-up gaze and absence of ipsilateral superior oblique overaction.[1]

Observation alone is appropriate for the mild congenital Brown syndrome. When Brown's syndrome is secondary to rheumatoid arthritis or another systemic inflammatory disease, resolution may occur because systemic treatment brings the underlying disease into remission or when corticosteroids are injected near the trochlea. Surgery is indicated for more severe congenital cases. The superior nasal oblique tenotomy against the superior rectus muscle is the definitive treatment; However, iatrogenic superior oblique paresis occurs in a minority of patients after this procedure. Careful handling of the intermuscular septum during surgery can reduce the incidence of these sequelae. To reduce the consequences of paralysis of the superior oblique muscle after tenotomy, some surgeons perform

ipsilateral inferior oblique muscle weakness concurrently. Other options include the insertion of an inert spacer or suture between the cut ends of the superior oblique tendon and split-tendon lengthening.[1,18]

Duane syndrome

Duane Syndrome or Duane Retraction Syndrome is a spectrum of ocular motility disorders characterized by anomalous contractions of the medial and lateral rectus muscle in actual or attempted adduction of one or both the involved eyes; this co-contraction causes the eyeball to be recoil.[1,9-10]

Most cases of Duane retraction syndrome are sporadic, but about 5%-10% show an autosomal dominant inheritance. Examples of links to more common disorders have been reported. The dispute in monozygotic twins raises the possibility that the intrauterine environment may play a role in the development of this syndrome. A higher prevalence in women was reported in most of the series, and there was a tendency for the left eye.[1,19]

The most widely used classification of Duane retraction syndrome defines 3 types, but the two may represent differences only in the severity of the horizontal rotation limitation. Type 1 refers to poor abduction, often with esotropia in the primary position; type 2 refers to poor adduction and exotropia; and type 3 refers to poor abduction and adduction, with esotropia, exotropia, or no deviation of the primary position. Approximately 15% of cases are bilateral; the type may differ between the 2 eyes. The spectrum of disinnervation between cases means that the classification of patients by this category can be arbitrary in some situations, particularly in deciding between type 1 and type 3. Synergistic divergence is a rare and peculiar motility disorder that is often classified as the fourth type of Duane syndrome. There is usually exotropia, and when the affected eye looks in the direction where adduction should result, it actually abducts further a colored finding described as "ocular split."Synergistic divergence can be unilateral or bilateral and can be caused by a bidirectional COL25A1 mutation.[1,20]

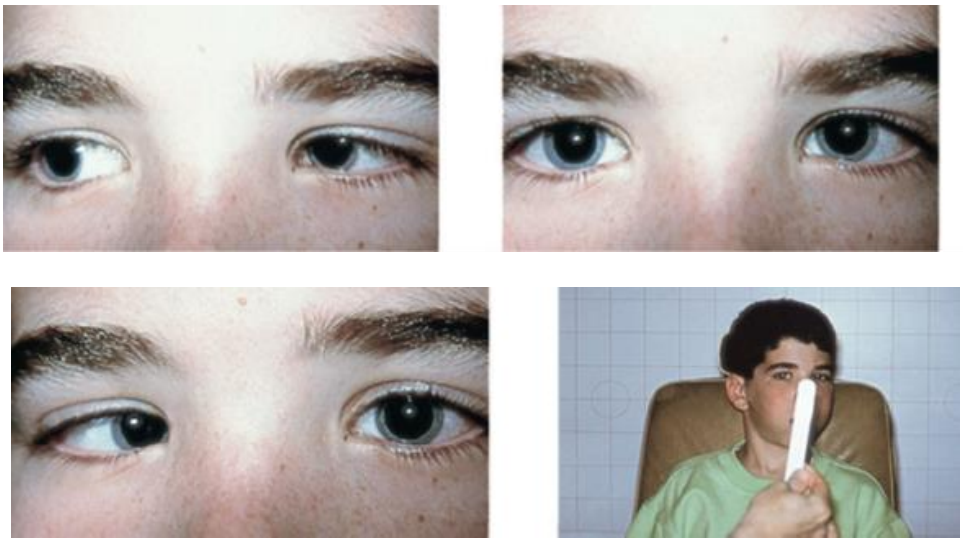

Figure 3. Duane retraction syndrome type 1 with esotropia, left eye, showing limited abduction, almost full adduction, and retraction of the eyeball on adduction. Far-right, Compensation head left turned.[1]

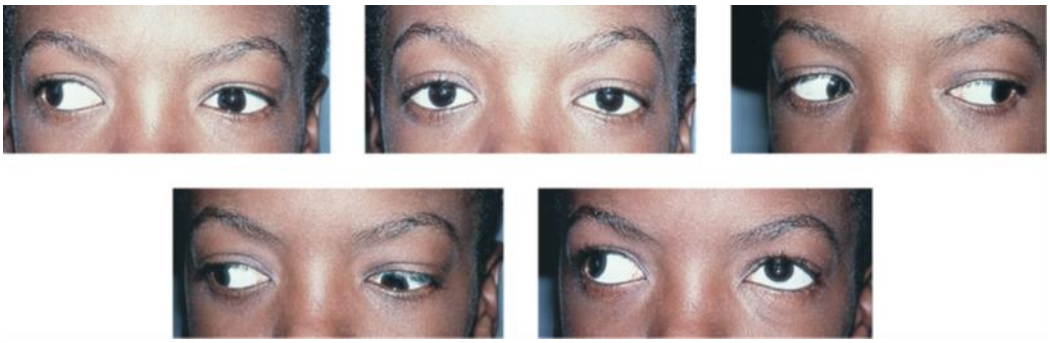

Figure 4. Duane retraction syndrome type 2, left eye. Upper row, Full abduction, and limited adduction. Bottom row, variable upshoots and downshoot left eye with extreme right gaze effort. Typical primary positional exotropia is absent in this patient.[1]

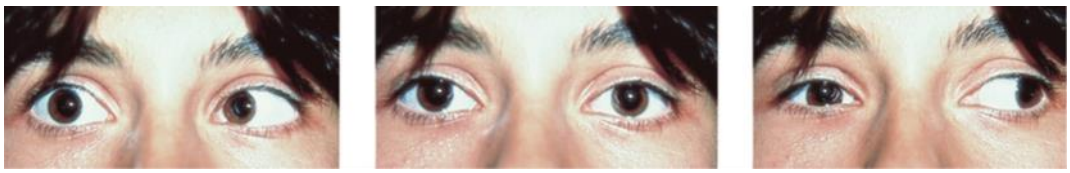

Figure 5. Duane retraction syndrome type 3, right eye. Severe limitation of abduction and adduction, with narrowing of the palpebral fissure, even though adduction cannot be performed. There is no deviation in the main position.[1]

For unilateral Duane retraction syndrome type 1, the recession of the medial rectus muscle on the involved side has been the most frequently used procedure to correct the primary positional deviation and eliminate head rotation. Adding recession of the opposite medial rectus (bilateral surgery) has been advocated by some surgeons, but the reasons are unclear, as this does not increase innervation to the lateral rectus muscle (as would be the case with sixth nerve paresis), and any decrease in medial rectus innervation is offset with a decrease in the anomalous innervation to the lateral rectus muscle of the involved eye. This surgery usually does not significantly improve abduction. Primary positional overcorrection may occur due to excessive medial rectus recession, and the resulting exotropia will worsen in the field of gaze where the involved eye is added. A recession of the lateral rectus of the uninvolved eye may offset this effect to some extent.[1]

The surgery most frequently recommended for Duane retraction syndrome type 2 is recession of the lateral rectus muscle on the involved side; medial rectus muscle resection is avoided. Some surgeons rest both lateral rectus muscles if large-angle exotropia is present, but when the fixating unaffected eye is operated on, the effect of increasing the contralateral medial rectus innervation (and associated lateral rectus anomalous innervation) should be noted.[1,20]

Patients with Duane retraction syndrome type 3 often have straight eyes near the primary eye position and do not require surgical treatment for minimal head rotation or horizontal strabismus. Retraction of the eyeball may be severe enough to warrant treatment and may be relieved by the recession of the medial and lateral rectus muscles, which may also reduce any upshoot or downshoot in addition. It is also an option for treating retractions in Duane retraction syndrome type 1 and type 2. The lateral recession must be large

to correct the retraction. Other procedures to treat upshoot or downshoot include separation of the lateral rectus muscle in a Y configuration, retro equatorial fixation of the lateral rectus muscle, and more recently, deactivation of the lateral rectus muscle, such as by disinsertion and reattachment to the lateral orbital periosteum with subsequent transposition procedures.[1]

2. Conclusion

Stereoscopic is the ability to perceive visual objects in the depth dimension (in the third dimension). Having a stereoscopic vision is a goal to be achieved. Brown Syndrome is a rare form of strabismus in which an ocular motility disorder is characterized by restriction of the elevation of the adducted eye, whereas Duane Syndrome is a spectrum of eye motility disorders characterized by anomalous contractions of the medial and lateral rectus muscles in actual or attempted adduction of one or both eyes involved. Diagnosis and therapy are performed depending on the underlying condition of the disorder.

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