

# Management of Duane's Syndrome with Botulinum Toxin Injection

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## Abstract

**Purpose:** Recession is the main surgical procedure in correction of eye deviation in Duane's syndrome. We evaluate the efficacy of botulinum toxin injection in the treatment of this type of strabismus instead of surgery or before it.

**Methods:** Three patients with Duane's syndrome type I and one patient with Type II were selected at Poostchi eye clinic from patients who diagnosed primarily and had not any eye surgery before. Botulinum toxin (Dysport™, 10 IU) was injected into medial or lateral rectus muscles under general (2 patients) or local (2 others) anesthesia. Amount of deviation, leash phenomenon and limitation of movements were measured pre injection and 72 hours, 1, 4, 12 and 24 weeks postinjections and the results were compared.

**Results:** The amount of deviation was decreased between 8-35 PD at 24 weeks postinjection. No significant change was observed in limitation of movement but leash phenomenon improved in 3 patients.

**Conclusion:** Injection of botulinum toxin in Duane's syndrome will decrease the amount of deviation and leash phenomenon; however, surgical intervention maybe necessary for residual deviation or globe retraction.

**Keywords:** Botulinum Toxin, Duane's Syndrome, Dysport, Strabismus

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## Introduction

Duane's syndrome was reported in 1905 by Mr. Duane who described it as absence or limitation in abduction associated with narrowing of palpebral fissure in adduction and globe retraction<sup>1</sup> and its cause was related to agenesis of sixth nerve nucleus. The morphologic changes are in favor of lateral rectus muscle fibrosis in this syndrome.<sup>2,3</sup>

In Duane's syndrome like congenital esotropia, trisomy of chromosome 8 was seen and it is proposed that Duane's syndrome and congenital esotropia are two allelic forms of one gene on chromosome 8.<sup>4</sup>

Usual treatment was surgical recession with success rate of 86-93%.<sup>5,6</sup>

Since botulinum toxin is used instead of surgery in weakening of extra ocular muscles and it was successful in congenital esotropia, it seems that it may also be successful in the treatment of Duane's syndrome and since its injection is non invasive it maybe preferable to surgery.<sup>7,8</sup>

Botulinum toxin is a protein derivate of bacterium clostridium botulinum and is available with trade names of Dysport and Botox.

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After direct injection into the extraocular muscle, it affects nerve endings during first 24-48 hours and remains for weeks and prohibits the release of acetylcholine. Muscle palsy is started between day 2-4 and in extraocular muscle its effect maintains for 5-8 weeks. It is proposed that extraocular muscle palsy leads to contraction of antagonist muscle and affects length-tension curve. Contraction of antagonist muscle and its adjustment with the new curve may improve ocular alignment in long term.<sup>9</sup>

In some studies, there was significant decrease in force generation specially in low frequency stimulation after injection.<sup>9</sup>

In this study the effect of botulinum toxin injection on eye deviation, limitation of movement and leash phenomenon were studied in Duane's syndrome in order to observe its positive effects as well as possible complications.

## Methods

In this interventional study, 4 patients with Duane's syndrome (three patients with type I and one patient with type II) were enrolled. Patients with Duane's type III as well as patients with any previous history of ocular surgery were excluded. After informing the patients or their parents regarding the effect of drug, its complications and the need for repeated injections or possibly operation, written consent was taken. Visual acuity (VA), refraction (manifest and cycloplegic) funduscopy and ocular motility were evaluated. Strabismus measured with alternative cover test and limitation of motion was measured and scored (Inability of the eye to pass from midline was scores as 4 and achieving full abduction considered as 0. The distance between them deviated into 3 equal parts (-3, -2, -1)). The amount of limitation in eye movement, presence of leash phenomenon and its direction (up or down) and head posture recorded in special forms and then compared with postinjection results at day 3 and then weeks 1, 4, 8, 12 and 24.

Botulinum toxin (Dysport, 10 IU) was injected by needle gauge 27 directly into the muscle belly without conjunctival opening and without use of EMG. In this regard, each 500 IU Dysport vial was dissolved slowly in 5 ml balanced salt saline solution and then 0.1 ml from the solution used for injection. This

procedure was preformed under general anesthesia in patients 1 and 4 but under local anesthesia in patients 2 and 3. Two months after first treatment, drug injection was repeated with the same dose in patients 3 and 4.

### Patient 1

A 2.5-year-old girl with Duane's syndrome type I in right eye

Cycloplegic refraction was  
OD: +1.00-0.25×30°, OS: +1.00-0.50×150°

Fundoscopy exam was normal. In this patient, 10 IU Dysport was injected in right medial rectus muscle.

### Patient 2

A 14-year-old girl with type I Duane's syndrome in the left eye

VA was  $^{20}/_{20}$  in both eyes. Cycloplegic refraction was plano.

Fundoscopy exam was normal. In this patient, 10 IU Dysport was injected into the left medial rectus muscle.

### Patient 3

A 24-year-old lady with type I Duane's syndrome in left eye

VA was  $^{20}/_{20}$  in both eyes. Cycloplegic refraction was  
OD: -0.5-0.50×30°, OS: Plano -1.25×180°

Fundoscopy was normal. In this patient Dysport was injected into left medial rectus muscle. Two months later, injection repeated with the same dose.

### Patient 4

A 4-year-old boy with bilateral Duane's syndrome, type II

VA was  $^{20}/_{30}$  in left eye and after correction improved to  $^{20}/_{20}$  in both eyes. Cycloplegic refraction was  
OD: +0.75-0.75×30°, OS: -1.75-0.50×150°. Fundoscopy was normal.

Ten IU Dysport was injected into the lateral rectus muscles of both eyes. Two months after the first injection, injection was repeated in both eyes.

## Results

The effect of drug on the amount of deviation, leash phenomenon and limitation of movement are shown in tables 1-3.

**Table 1.** Amount of deviation before and after injection

Patient	Type & Amount of deviation				
	Before injection	1 week	1 mo	2 mo¶	6 mo
1	x: Ortho ■: 45 ΔD ET	x: Ortho ■: 30 ΔD	x: Ortho ■: 30 ΔD	x: Ortho ■: 30 ΔD	x: Ortho ■: 30 ΔD ET
2	x: 8 ΔD ET (OS)	x: 45 XT (OS)	x: No deviation	x: No deviation	x: No deviation
3	x: 35 ΔD ET (OS)	x: 18 ΔD ET	x: 25 ΔD ET	x: 25 ΔD ET¶	x: 20 ΔD ET
4	x: 70ΔD XT 20 ΔD DVD (OD)	x: 30 XT 15 DVD	x: 30 XT 20 DVD	x: 30 XT¶ 20 DVD	x: 35ΔD XT 15 ΔD DVD

x : Primary position  
 □ : Gaze to the left  
 ■ : Gaze to the right  
 ¶ : Re-injection

**Table 2.** Leash phenomenon before & after injection

Patient	Leash			
	Before injection	1 mo	3 mo	6 mo
1	No leash	No leash	■ Down sh	■ Up sh & Down sh
2	No leash	No leash	□ Up sh	□ Up sh
3	■ Mild Up sh	■ Up sh	■ Up sh	■ Down & Up sh
4	■ Up sh □ Down sh	■ Up sh □ Down sh	■ Up sh □ Down sh	■ Up sh □ Down sh

□ : Gaze to the left  
 ■ : Gaze to the right  
 sh: shoot

**Table 3.** Limitation of movement before & after injection

Patient	Limitation of motion				
	Before injection	72 hours postinjection	1 mo	3 mo	6 mo
1	Right eye in abduction -3	-3	-1	-1	-1
2	Left eye in abduction -4	-4	-4	-4	-4
3	Left eye in abduction -4	-4	-4	-4	-4
4	Right eye in adduction -3	Right eye -3	Right eye -3	Right eye -3	Right eye -1
	Left eye -2	Left eye -2	Left eye -2	Left eye -1	Left eye -1

It is evident that injection of drug in all of the patients were led to significant decrease in amount of deviation: In patient number 2, it cured 8 PD of esotropia and in patients 1, 3 and 4, it decreased the amount of deviation about 15, 15 and 35 PD respectively.

Six months after the injections, leash phenomenon improved in patients 1, 2 and 3 but in patient number 4 it didn't affect the leash. Limitation of movement improved in patients number 1 and 4 but it didn't affect limitation of movement in patients 2 and 3.

Significant head posture was not detected in patients except patient number 3, who had 25° head turn which didn't change after second injection even though its deviation decreased about 15 PD.

Regarding complications, one of the patients (patient 2) developed diplopia at near, two weeks after injection which resolved in the second months of follow-up. Patients 3 and 4 developed ptosis after 1 month from the first injection which were resolved during the next 2-4 weeks. One of them (patient 3) also developed complete ptosis after the second injection which was recovered during next two months.

## Discussion

In most reports, recession showed high success in the treatment of Duane's syndrome.<sup>5,6</sup> Maintenance of fusion in most of the patients as well as infrequency of amblyopia in this syndrome leads to differing treatment until age 6.<sup>1</sup> The goal of surgery in this way is correction of deviation in primary position, maintenance of fusion and improvement of head posture.<sup>10</sup> Other surgical methods including recession and splitting of lateral rectus muscle, fixation of lateral rectus muscle into orbital wall and vertical rectus muscle transposition with or without medial posterior fixation suture were tried in Duane's syndrome type I.<sup>11-15</sup>

None of the above mentioned surgical procedures could significantly improve limitation of movement in this syndrome. Since botulinum toxin injection is successful in treatment of many eye deviations like cranial nerve palsies,<sup>16</sup> congenital esotropia,<sup>17</sup> congenital nystagmus, congenital torticollis

and so on,<sup>7,18-20</sup> it is expected to act similar to surgery in Duane's syndrome as well. With weakening of the desired muscle, it is expected to decrease the amount of eye deviation and leash phenomenon. It is obvious that it may not affect limitation of movement. In both of two patients of Duane's syndrome who were previously reported to be treated by botulinum injection, amount of deviation decreased, head posture improved and leash phenomenon decreased partially.<sup>7,8</sup>

In our study, injection of botulinum toxin A (Dysport) significantly decreased the amount of deviation. It seems that it acts like surgical recession of the muscle which affects its paralytic etiology but not restrictive causes. Leash phenomena decreased partially. It didn't affect limitation of movement. Because of change in length-tension curve of the muscle it is expected that the correction remains relatively permanently after injection and after resolving the temporary effect of the toxin. Follow-up of patients were in accordance with this fact. Our results showed that although toxin injection may not completely resolve the need for surgery, it may lessen the needs to complex interventions during surgical approaches by decreasing leash phenomenon and amount of deviation.

On the other hand, since it can be performed by local anesthesia and without conjunctival opening, it is a noninvasive procedure which has no significant complications.

## Conclusion

Botulinum toxin injection could be considered in the treatment of Duane's syndrome before proceeding to surgery because of lower chance of amblyopia in these patients and since delay in treatment is not an important concern in this situation. It is obvious that toxin injection is not effective for treatment of restrictive consequences in this syndrome and unaffected limitation of movement in our case series confirms this idea. It seems necessary to evaluate the effect of toxin injection in long term in this syndrome to conclude its positive effect. Further studies are recommended.

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