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The Efficacy of Botulinum Toxin Treatment for Children with a Persistent Esotropia Following Bilateral Medial Rectus Recessions and Lateral Rectus Resections

Scott R. Lambert, M.D. and Marla J. Shainberg, C.O.

Department of Ophthalmology, Emory University, Atlanta, GA

Abstract

Background and Purpose—To report on the outcomes of treating children with a persistent esotropia with an injection of botulinum toxin in a medial rectus muscle.

Patients and Methods—The medical records of all children at one institution with a persistent esotropia after bilateral medial rectus recessions and bilateral lateral rectus resections who were then treated with a botulinum toxin injection were reviewed.

Results—Five patients with a mean preoperative esotropia of 37 PD (range, 25-50 PD) underwent bilateral medial rectus recessions and then bilateral lateral rectus resections. Their residual esotropia (mean, 25 PD; range, 18-35) was then treated with a single injection of 3- 5 units of botulinum toxin into one medial rectus muscle. The patients were then followed for a mean of 34 months (range, 14 to 79 months). At last follow-up, 2 patients had an esotropia <10 PD. The other 3 patients had no long-term improvement in their ocular alignment. Two of these patients then underwent additional strabismus surgery. In both cases, they then developed a consecutive exotropia.

Conclusion—Treatment with a single injection of botulinum toxin was beneficial in 2 of 5 children. Botulinum toxin treatment alone did not result in a consecutive exotropia in any patients treated.

Keywords

Botulinum toxin; persistent esotropia; consecutive exotropia

Botulinum was developed as a pharmacological treatment for strabismus.¹ It was approved by the Food and Drug Administration for the treatment of strabismus in 1989. However, there continues to be controversy regarding its long-term efficacy in patients with strabismus. A recent Cochrane review identified four randomized clinical trials (RCTs) evaluating the use of botulinum toxin in patients with strabismus.² One of these RCTs

Reprints may be requested from Scott R. Lambert, M.D., Emory Eye Center, 1365-B Clifton Rd, Atlanta, GA 30322, slamber@emory.edu, phone: 404-778-4417, Fax: 404-778-5208.

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reported no difference in the recovery rate of patients with acute unilateral sixth nerve palsies randomized to observation versus early treatment with botulinum toxin.³ Another reported worse outcomes in adults with no binocularity randomized to treatment with botulinum toxin versus strabismus surgery.⁴ The last two RCTs reported that botulinum toxin was as effective as strabismus surgery for the retreatment of children with infantile esotropia and acquired esotropia following bilateral medial rectus recessions.^{5, 6} We report our experience treating children with a residual esotropia following both bilateral medial rectus recessions and lateral rectus resections with a single injection of botulinum toxin.

Material and Methods

The medical records for patients coded with the CPT code 67345 (chemodenervation of extraocular muscle) treated by one of the authors (SRL) between January 1999 and September 2012 were reviewed. This study was approved by the institutional review board of Emory University and was in compliance with the Health Insurance Portability and Accountability Act. To be included in the study patients had to have had an infantile or acquired esotropia without any other ocular pathology and to be <18 years of age at the time of treatment with botulinum toxin. In addition, each patient had to be wearing their full cycloplegic refraction if they had +1.00 diopters or more of hyperopia in either eye prior to botulinum treatment and to be followed for 12 months or longer after treatment with botulinum toxin.

The botulinum toxin injections were all performed using BOTOX® (Allergan). Electromyographic guidance was used to localize the rectus muscles in all cases. Botulinum toxin injections for teenagers and adults were performed in the clinic using topical anesthesia and for children in the operating room using inhalational anesthesia.

Results

The medical records were reviewed for 63 of 90 patients with strabismus treated with a botulinum toxin injection between 1999 and 2012. The medical record was not available for review for 27 patients. Forty-six adults were treated with one or more botulinum toxin injections for the following conditions: cranial nerve VI palsies (n=26), residual/recurrent esotropia (n=7), consecutive esotropia (n=6), exotropia (n=3), cranial nerve III palsies (n=3) and esotropia following pterygium repair (n=1). Seventeen children were treated with one or more botulinum toxin injections for the following conditions: consecutive esotropia (n=7),⁷ residual/recurrent esotropia (n=7), cranial nerve VI palsy (n=2), exotropia (n=1), and Moebius syndrome (n=1). Of the 7 patients treated for a recurrent/residual esotropia, 1 was treated with a botulinum toxin injection after bilateral medial rectus recessions alone and therefore was not included in the analysis. The other 6 patients were treated with a botulinum toxin injection for a recurrent/residual esotropia following bilateral medial rectus recessions and lateral rectus resections. One of these patients was excluded from the analysis because the follow-up was <12 months.

The clinical findings for the 5 patients studied are summarized in Table 1. Four of the 5 patients had infantile onset esotropia. The mean esotropia prior to strabismus surgery was 37

PD (range, 25-50 PD). Initially, all of the patients underwent bilateral medial rectus recessions. Because of a recurrent or residual esotropia, they all then underwent bilateral lateral rectus resections 7 months to 3 years later. Lastly, they all underwent the injection of 3- 5 units of botulinum toxin into one medial rectus muscle. Prior to treatment with botulinum toxin, the mean angle of esotropia was 25 PD (range, 18-35 PD). Two patients developed transient blepharoptosis. Patient 3 developed a hypertropia in the treated eye and later developed a dissociated vertical deviation and amblyopia in the treated eye. Despite patching therapy, his best corrected visual acuity was only 20/80 in the eye treated with botulinum toxin versus 20/20 in the fellow eye when last examined at age 8 years. The other 4 patients all had equal vision in both of their eyes at their last follow-up examination.

The patients were followed for a mean of 34 months after treatment with botulinum toxin (range, 14 to 79 months). At their last follow-up, Patients 3 and 5 had an esotropia <10 PD wearing their full hyperopic correction. Both patients had moderate hyperopia (Patient 3, RE: +1.75 +2.00 $\times$ 85; LE +2.50 +1.25 $\times$ 95; Patient 5, RE: +2.00 +1.25 $\times$ 138; LE: +2.50 +1.50 $\times$ 27) and without correction of their hyperopia had a larger esotropia. The other 3 patients had no long-term improvement in their esotropia following treatment with botulinum toxin. Patient 5 fused with the Worth 4-dot test. None of the other patients had any measurable fusion or stereopsis. Two patients underwent additional strabismus surgery. Patient 1 underwent bilateral medial rectus re-recessions and patient 4 a unilateral medial rectus re-recession and lateral rectus re-resection. Both patients subsequently developed a consecutive exotropia. Patient 4 later underwent two additional strabismus surgeries to correct a consecutive exotropia. At his last follow-up, Patient 1 had an intermittent exotropia of 8 PD in the distance and 14 PD at near. Patient 2 has not undergone any additional strabismus surgery but continues to have a cosmetically significant esotropia.

Discussion

Treatment with Botulinum toxin injection was effective in two patients with an infantile or acquired esotropia who remained undercorrected after bilateral medial rectus recessions and lateral rectus resections. Botulinum toxin treatment was ineffective in the other 3 patients in this series. However, only one botulinum toxin injection was administered to each patient in this series. Administering additional injections many have resulted in improved outcomes. In most studies evaluating the efficacy of botulinum injections for treating esotropia, bilateral and often multiple injections have been administered.^{8, 9} Localizing the medial rectus muscle for the patients in our series was quite difficult because they had all been recessed previously. Difficulty localizing the medial rectus muscle may have reduced the effectiveness of the botulinum toxin injections. Finally, the injections were administered for all but one of the patients while they were receiving inhalational anesthesia which dampens the EMG signal and makes it more difficult to accurately localize the extraocular muscles.

It is difficult to generalize the results of our series given the limited number of patients we treated. However, other larger series have reported that botulinum can be an effective treatment for a small angle esotropia. Biglan and coworkers¹⁰ reported a series of 48 patients with a small residual exotropia or esotropia following strabismus surgery who were treated with one or more botulinum toxin injections (23% received more than one injection).

In their series, the mean pre-injection deviation was 20 PD and the mean post-injection deviation was 11 PD. However, they did not separately analyze patients with a residual exotropia or esotropia so it is not directly comparable to our series. Tejedor and Rodriguez⁶ compared the efficacy of a second strabismus surgery versus botulinum toxin injections for 55 children with infantile esotropia who were either undercorrected or overcorrected after bilateral medial rectus recessions. They reported similar rates of motor alignment with both treatments (strabismus surgery, 68%; botulinum injections, 60%) after a 3 year follow-up. Tejedor and Rodriguez⁵ performed a similar study for 47 children with acquired esotropia who were under or overcorrected after bilateral medial rectus recessions or a unilateral medial rectus recession and lateral rectus resection. After a one year follow-up, there was a similar incidence of motor alignment between the two treatment groups (strabismus surgery, 75%; botulinum injection, 70%). They concluded that botulinum injections may be as effective as a second strabismus surgery when managing patients with an under or overcorrection. Our series differs from these series in that all of the patients in our series had already undergone two strabismus operations rather than only one previous surgery. In addition, the present analysis only evaluated patients with a residual or recurrent esotropia rather than also analyzing patients with consecutive exotropia.

Spectacles were required in two of the patients in our series to maintain ocular alignment after a botulinum toxin injection. Hiles and coworkers¹¹ have reported that 65% of patients with infantile esotropia require spectacles at some point in their postoperative course to maintain ocular alignment.

One potential advantage of treating patients with a persistent esotropia with a botulinum toxin injection after multiple strabismus surgeries is that it may reduce the risk of inducing a consecutive exotropia. The two patients in our series who developed a consecutive exotropia both underwent a third strabismus surgery. Children with infantile esotropia who undergo strabismus surgery are at a particularly high risk of developing a consecutive exotropia. Ciancia (Knapp lecture, AAPOS 2011, pg. 22) reported a 21% incidence of consecutive exotropia (>10PD) after long-term follow-up in patients with infantile esotropia after strabismus surgery. Multiple strabismus surgeries likely increase the risk of developing a consecutive exotropia even further in patients with infantile esotropia.¹²⁻¹⁴ In contrast, the risk of developing a consecutive exotropia after botulinum toxin injections in patients with esotropia has been reported to be quite low.^{8, 9}

In conclusion, treatment with a single injection of botulinum toxin was beneficial in 2 of 5 children who had a persistent esotropia after bilateral medial rectus recessions and lateral rectus resections. One of the greatest advantages of treating patients with a persistent esotropia with an injection of botulinum toxin treatment is the relatively low risk of inducing a consecutive exotropia.

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Table 1

Clinical Findings

Patient #	Diagnosis	Original ET (PD)	Surgery prior to BTXA injection (mm)	Age (mo) BTXA injection	ET (PD) before BTXA injection	ET (PD) post BTXA injection	Follow-up (mo) post Injection
1	Infantile Esotropia	30	BMR-5 BLR+6	51	D: 30 N: 30	D: 30 N: 30	28
2	Infantile Esotropia	50	BMR-6 BLR+6	25	D: 20 N: 20	D: 25 N: 35	14
3	Infantile Esotropia	50	BMR-6 BMR+6	18	18	D: 0 N: 0	79
4	Infantile Esotropia	25	BMR-4.5 BLR+5.5	108	35	D: 18 N: 18	35
5	Partial Accommodative Esotropia	30	BMR-4.5 BLR+5 BMR pulley fixation	204	D: 20 N: 30	D: 0 N: 8	14

BMR=bilateral medial rectus recessions; BLR=bilateral lateral rectus resections; D=distance; N=near; BTXA=botulinum toxin A; ET=esotropia; PD=prism diopters
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