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

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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 were reviewed of all children at one institution with a persistent esotropia after bilateral medial rectus recessions and bilateral lateral rectus resections then treated with a botulinum toxin injection.

Results: Five patients with a mean preoperative esotropia of 37° (range 25-50°) underwent bilateral medial rectus recessions and then bilateral lateral rectus resections. Their residual esotropia (mean of 25°; 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 14-79 months). At last follow-up, two patients had an esotropia <10°. The other three 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.

INTRODUCTION

Botulinum toxin was developed as a pharmacological treatment for strabismus. 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. One of these RCTs reported no difference in the recovery rate of patients with acute unilateral sixth-nerve palsies randomized to observation versus early treatment with botulinum toxin. Another reported worse outcomes in adults with no binocularity randomized to treatment with botulinum toxin versus
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 twenty-seven patients. Forty-six adults were treated with one or more botulinum toxin injections for the following conditions: cranial sixth-nerve palsies (n = 26), residual/recurrent esotropia (n = 7), consecutive esotropia (n = 6), exotropia (n = 3), cranial third-nerve 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), residual/recurrent esotropia (n = 7), cranial sixth-nerve palsy (n = 2), exotropia (n = 1), and Moebius syndrome (n = 1). Of the seven patients treated for a recurrent/residual esotropia, one was treated with a botulinum toxin injection after bilateral medial rectus recessions alone and therefore was not included in the analysis. The other six 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 five patients studied are summarized in the Table. Four of the 5 patients had infantile onset eso-

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, Inc.). 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 twenty-seven patients. Forty-six adults were treated with one or more botulinum toxin injections for the following conditions: cranial sixth-nerve palsies (n = 26), residual/recurrent esotropia (n = 7), consecutive esotropia (n = 6), exotropia (n = 3), cranial third-nerve 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), residual/recurrent esotropia (n = 7), cranial sixth-nerve palsy (n = 2), exotropia (n = 1), and Moebius syndrome (n = 1). Of the seven patients treated for a recurrent/residual esotropia, one was treated with a botulinum toxin injection after bilateral medial rectus recessions alone and therefore was not included in the analysis. The other six 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 five patients studied are summarized in the Table. Four of the 5 patients had infantile onset eso-
tropia. The mean esotropia prior to strabismus surgery was $37^\Delta$ (range 25-50$^\Delta$). 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 $25^\Delta$ (range 18-35$^\Delta$). Two patients developed transient blepharoptosis. Patient Three 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 four 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 14-79 months). At their last follow-up, Patients Three and Five had an esotropia $<10^\Delta$ wearing their full hyperopic correction. Both patients had moderate hyperopia (Patient Three, RE: +1.75 +2.00 x 85; LE +2.50 +1.25 x 95; Patient Five, RE: +2.00 +1.25 x 138; LE: +2.50 +1.50 x 27) and without correction of their hyperopia had a larger esotropia. The other three patients had no long-term improvement in their esotropia following treatment with botulinum toxin. Patient Five 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 One underwent bilateral medial rectus re-recessions and Patient Four a unilateral medial rectus re-recession and lateral rectus re-resection. Both patients subsequently developed a consecutive exotropia. Patient Four later underwent two additional strabismus surgeries to correct a consecutive exotropia. At his last follow-up, Patient One had an intermittent exotropia of $8^\Delta$ in the distance and $14^\Delta$ at near. Patient Two 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 three 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.\(^6,^9\) 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 toxin can be an effective treatment for a small-angle esotropia. Biglan et al. reported a series of forty-eight patients with a small residual exotropia or esotropia following strabismus surgery and then treated with one or more botulinum toxin injections (23% received more than one injection).\(^10\) In their series, the mean pre-injection deviation was 20\(^\Delta\) and the mean post-injection deviation was 11\(^\Delta\). However, they did not separately analyze patients with a residual exotropia or esotropia so it is not directly comparable to our series. Tejedor and Rodriguez compared the efficacy of a second strabismus surgery versus botulinum toxin injections for fifty-five children with infantile esotropia who were either undercorrected or overcorrected after bilateral medial rectus recessions.\(^6\) They reported similar rates of motor alignment with both treatments (strabismus surgery, 68%; botulinum injections, 60%) after a 3-year follow-up. Tejedor and Rodriguez performed a similar study for 47 children with acquired esotropia who were under- or over-corrected after bilateral medial rectus recessions or a unilateral medial rectus recession and lateral rectus resection.\(^5\) After a 1-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 et al. have reported that 65% of patients with infantile esotropia require spectacles at some point in their postoperative course to maintain ocular alignment.\(^11\)

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 2001, pg. 22) reported a 21% incidence of consecutive exotropia (>10°) 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. In contrast, the risk of developing a consecutive exotropia after botulinum toxin injections in patients with esotropia has been reported to be quite low.\(^8,^9\)

**CONCLUSION**

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 resections 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.

**REFERENCES**


**Key words:** botulinum toxin, persistent esotropia, consecutive exotropia