

# A Prospective Study on the Use of Botulinum Injection and Horizontal Strabismus in Children

## Abstract

Strabismus is a condition in which the eyes are not properly aligned with each other. Different treatment options are available to treat strabismus. Surgery is considered to be the cornerstone of strabismus management when all else fails. However treatment with botulinum toxin has been seen to produce good results in the short also with one study showing better results than one surgical series and atleast similar results to the other published surgical series. As the surgical intervention is a more invasive procedure, if the same effect can be achieved by the botox injection, it provides an attractive option to patients. Our research aims to probe into this better alternative and thus looking at the long term effect of botulinum toxin on patients who have binocularity potential versus those who had no binocularity.

**Keywords:** Strabismus; Botulinum toxin; Binocularity potential

## Research Article

Volume 2 Issue 4 - 2015

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**Received:** June 04, 2015 | **Published:** June 15, 2015

## Introduction

Strabismus (Modern Latin, from Greek "to squint", "squinting, squint-eyed") is a condition in which the eyes are not properly aligned with each other [1]. It typically involves a lack of coordination between the extraocular muscles, which prevents bringing the gaze of each eye to the same point in space and preventing proper binocular vision, which may adversely affect depth perception. The estimated prevalence of strabismus in the general population is from 2 to 6 percent [2].

The injection of Botulinum Toxin Type A has been used as an alternative to conventional incisional surgery in selected strabismic patients [3]. While the reversibility of the botulinum toxin effect by fading out after 3-4 months is seen as an advantage, it does also mean that in these cases of constant strabismus it is necessary to keep repeating the injections [4]. However permanent effects of Botulinum toxin have also been observed. The permanent therapeutic effects of BoNT most likely do not cause permanent changes at the level of the peripheral effectors organ, but rather involve central (CNS) adaptive responses [5]. Treatment with botulinum toxin seemed to produce better results than one surgical series and atleast equally similar result to the other published surgical series [6]. We describe a prospective study aimed to test efficacy of botulinum toxin injections in attaining ocular alignment in children presenting with horizontal strabismus.

## Methods

53 children aged 0.75 to 18.92 years (mean 8.5 years) with horizontal misalignments presenting in Outpatient clinic of Institute of Ophthalmology, Mayo Hospital Lahore were selected, Our primary indication for treatment with botulinum was for children who had a potential for binocularity either on the basis of preoperative assessment for binocularity and/or a positive post operative diplopia test with a an area of single vision either at the angle of deviation or within 10 dioptres of orthophoria. The other

indications were cosmesis, prevention of contracture in paretic strabismus and angle reduction in residual horizontal deviations in children who had undergone previous surgery. Children were followed up at 1 week, 3 weeks, 6 weeks, 3 months and finally at 6 months. For some patients follow up was available for 1 year.

Pre operative assessment consisted of visual acuity using LogMAR Lea Chart, a complete ocular and orthoptic examination including cycloplegic retinoscopy. If indicated, spectacles were worn and amblyopia was treated with occlusion therapy. Potential for binocularity was assessed after neutralization of the strabismic angle with prisms. Fusion was assessed with Bagolini striated lenses and binocularity was assessed by neutralizing deviation with prisms. Patient's stereopsis with Frisby Stereo test and prism fusion range was measured in free space with prism bars. Post operative diplopia was tested using prism bars. The prism range of diplopic vision and the area of single vision in range of prism dioptres were determined.

Botulinum injections were given when sequential assessments of the strabismic angle showed stability ( $\pm 5$  prism dioptres for distance or near) on two successive visits. In addition, occlusion therapy was complete to achieve best possible visual acuity based on LogMAR Lea test. Botulinum injections were given under Ketamine anaesthesia with audio EMG control. Doses ranged from 1.25-5.0 international units for any one muscle depending on the angle of deviation. In some patients, two muscles were injected. Single muscle injections were in the deviating eye and bilateral injections either when the deviation was large (greater than 30 prism dioptres) or when there was an alternating squint.

## Results for potential for binocularity

23 patients aged between 1.08 years 1 and 18.9 years were chosen. Mean 8.25 years. 13 of the 23 patients (56.52%) attained microtropia at 6 month follow up while 10 were under corrected. 3 out of the 10 patients had a reduction in deviation of more than 50% at 6 months follow up.

## Results for diplopia trial

14 patients aged between 6.58 years and 17.33 years (mean 11.17 years). 5 patients were lost to follow up. 5 of the remaining 9 patients (55.57%) attained microtropia at 6 month follow up while 4 were under corrected but had a change in deviation of more than 50%.

## Results for cosmesis

13 patients aged between 1 year and 17.25 years (mean 7.25) were chosen. 3 patients were lost to follow up. 2 patients of the remaining 10 (20%) attained microtropia while 8 had residual deviation at 6 months visit. 3 out of the 8 patients had a change of deviation of greater than 50%.

## Results for contracture prevention

2 patients aged 0.75 and 2.83 years were chosen. There was no change in deviation seen in either patient with both having a repeat of injection botulinum toxin.

## Results for residual angle reduction

1 patient aged 7.5 year was in this group. The distance deviations remained unchanged while the deviation for near decreased by 4 Prism dioptre (28.57%) and underwent further botulinum toxin injections.

## Discussion

Strabismus is a condition in which the eyes are out of alignment which may develop in childhood or may be acquired as an adult [7]. It occurs in upto 5% of the population and is present in up to 50% of special patients such as those with cerebral palsy [8-10]. Treatment for strabismus is directed at aligning the visual axis. Conservative treatment includes prisms and orthoptic exercise while the invasive options include surgery and botulinum toxin [7].

Type A botulinum toxin produced by clostridium botulinum causes temporary muscle paralysis in humans, and injection with toxin in extra-ocular muscles as an alternative to strabismus surgery was first described by Alan Scott in 1973 [11]. The strabismic indications for Botulinum toxin injection range from small to moderate angle, comitant strabismus with potential for binocularity [12,13], adjuvant procedure following incisional strabismus surgery [14], paralytic strabismus to relieve diplopia and to prevent contraction of the antagonist muscle [15-19], restrictive strabismus example thyroid eye disease [20,21], Congenital and acquired nystagmus and oscillopsia [22], Internuclear ophthalmoplegia [23] and convergence spasm [24]. To the best of our knowledge, this is the first prospective study in Pakistan looking at the effect of botulinum toxin injection on strabismic patients with and without binocularity potential.

Our study showed that the incidence of permanent therapeutic effect of botulinum toxin is more for patients who have potential for binocularity and much less for those without any binocularity potential. Of the total 32 patients with binocularity potential (binocularity potential and post op diplopia patients) who were followed up till 6 months, 18 (56.25%) attained microtropia

while 7 of the 14 under corrected patients (50%) had a change in deviation of more than 50% and thus required lesser surgery. On the other hand, of the 13 patients with no binocularity potential, 2 (15%) attained microtropia at 6 months follow up. Patients with no potential for binocularity thus either require repeated injections or undergo extraocular muscle surgery.

## Conclusion

Injection botulinum toxin can achieve long term excellent alignment on patients with horizontal strabismus having binocularity potential; the effect lasting for more than the usual 3-4 months. Selection of the patient is thus very critical to obtain long term ocular alignment with injection botulinum toxin and thus avoid the need of surgery. More research into the long term effect of botulinum toxin injection for strabismus having binocularity potential is required before widespread adoption of injection as an alternate to surgery is adopted.

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