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Original Research Article

The Use of Botulinum Toxin to Treat Infantile Esotropia

Chaabani Lotfi[1*], Ksouri Sifeddine[1], Doulemi Yosra[2], Whibi Aicha[2]

[1]Ophtalmology department of Kasserine Hospital Center 1200 Tunisia, University of Medicine of Sousse, Tunisia
[2]Stomatology department of Metlaoui Hospital center, University of Dental Medicine of Monastir, Tunisia

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Abstract: Injection of botulinum toxin type A into both rectus muscles is an alternative to surgery and has given good results in children with infantile esotropia. Reducing the angle of deviation can help restore binocular vision, which in turn will promote motor fusion and allow better control of the strabismus and may even lead to eventual healing.We report the result after 6 months of injection of botulinum toxin in the medial rectus in 6 children with infantile esotropia.

Keywords: Botulinum toxin, infantile esotropia, early surgery, medial rectus muscle.

INTRODUCTION

Botulinum toxin is a natural toxin. It works by blocking the release of acetylcholine in the synaptic cleft of the neuromuscular junction, causing chemical denervation of the muscle and leading to a decrease in muscle strength. The effect of the toxin is temporary and lasts about three months [1]. It was first used in the treatment of infantile esotropia in 1980 by Scott and is now an effective alternative to traditional surgery for patients with early strabismus [2].

The aim of our work is to evaluate the effectiveness, after 6 months, of botulinum toxin injection on a series of 6 cases of infantile esotropias treated before the age of 36 months.

METHODS

This is a retrospective study involving 6 children with early onset esotropia appearing before the age of 12 months and surgically treated before the age of 36 months by a single surgeon. All patients underwent a parental interview, a complete ophthalmological examination, and a preoperative motor and sensory orthoptic assessment. The treatment had two components:

- Medical treatment: Total and permanent optical correction for all patients and amblyopia treatment.
- Surgical treatment: Injection of botulinum toxin into both medial rectus muscles.

The age of the patients at the time of injection ranged from 18 to 30 months. All presented with permanent esotropia that did not resolve with total optical correction. The measured esodeviation with optical correction ranged from 20 to 60 diopters. Adduction fixation, latent manifest nystagmus (LMN), and dissociated vertical deviation (DVD) were inconsistently present. Other less specific elements of the syndrome were also found, such as adduction elevation and alphabetic syndromes.

A first examination under cycloplegia with total optical correction was performed to correct any ametropia. Parents received comprehensive oral information regarding early strabismus, the principles, the purpose, and the side effects of treatment with botulinum toxin in particular (transient secondary exotropia, transient ptosis, and the possibility of secondary surgical treatment). The injection was performed under general anesthesia in an outpatient setting and under an operating microscope. A conjunctival buttonhole was created at the medial rectus muscle tendon, which was loaded onto a hook for proper isolation (Figure 1) after a dilution of 2.5 ml of saline for 500 IU to achieve 20 IU per 0.1 ml. The injection was done using a 30 G needle and slowly to limit the diffusion of the toxin outside the muscle. The injected dose was based on the angle of deviation (Table 1). Five children received an injection of 0.1 ml (20 IU) in each medial rectus muscle as the angle of deviation exceeded 20

***Corresponding Author:** Chaabani Lotfi
Ophtalmology department of Kasserine Hospital Center 1200 Tunisia, University of Medicine of Sousse, Tunisia

diopters, while one child with an esodeviation of less than 20 diopters received an injection of 0.05 ml (10 IU).

A postoperative topical treatment combining an antibiotic and a corticosteroid was prescribed for 15 days. Monitoring was weekly during the first few weeks to check for side effects, particularly signs of botulinum toxin diffusion (ptosis, vertical deviation, etc.). The effectiveness of the toxin was evaluated at 1 month, 3 months, and then at 6 months through an ophthalmological examination and a postoperative motor and sensory orthoptic assessment. An optimal success rate is defined as a residual strabismus of 10 Δ or less. Skiascopy was repeated 3 to 6 months after the injections to detect and correct any potential refractive changes.

RESULTS

Our study included 6 children, comprising 3 boys and 3 girls. The age of the patients at the time of the first consultation ranged from 10.8 months to 12 months, with an average of 22.8 months. The mean spherical equivalent refraction was +2.8 diopters, with extremes ranging from -1.25 to +4.50. The injection was performed between 18 months and 30 months of age, with an average of 22.8 months (Table 2). No intraoperative complications were noted. There were 5 cases of transient bilateral ptosis (Figure 2). This ptosis persisted between 21 days and 1 month and was not obstructive. It always regressed completely. We did not observe any loss to follow-up. The comparison of preoperative and postoperative orthoptic assessments showed improvement starting from 3 months after the injections in all patients (Figure 3). The final strabismic deviation after a single injection was less than 10 diopters in all cases (Table 3).

Table 1: Dose of injected toxin (Dysport®) based on the angle of deviation

Angle of deviation	Angle greater than 20 PD	Angle less than 20 PD
dose of botulinum toxin	20 IU	10 IU

Table 2: Age of patients at the time of botulinum toxin injection

Patient	Age at the time of injection
1	24
2	20
3	20
4	19
5	30
6	24
7	22,8

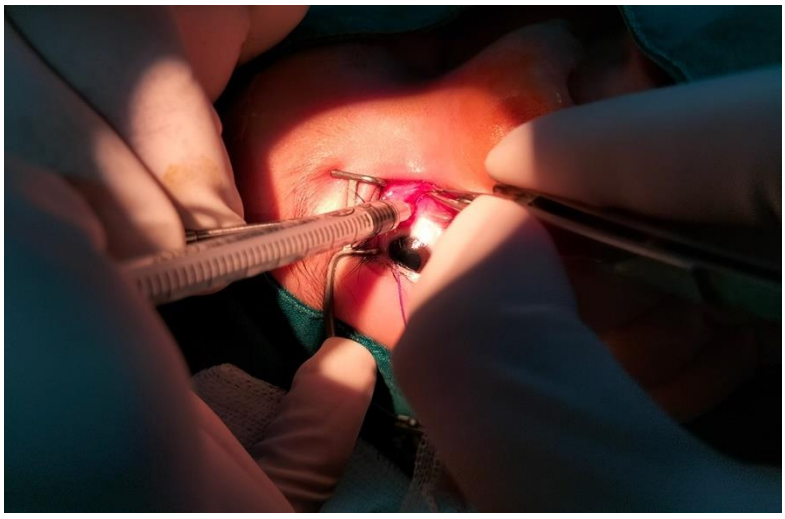

Fig 1: Technical injection: A conjunctival buttonhole was created at the medial rectus muscle tendon, which was loaded onto a hook for proper isolation

Fig 2: Results after 15 days from the injection: transient bilateral not obstructive ptosis

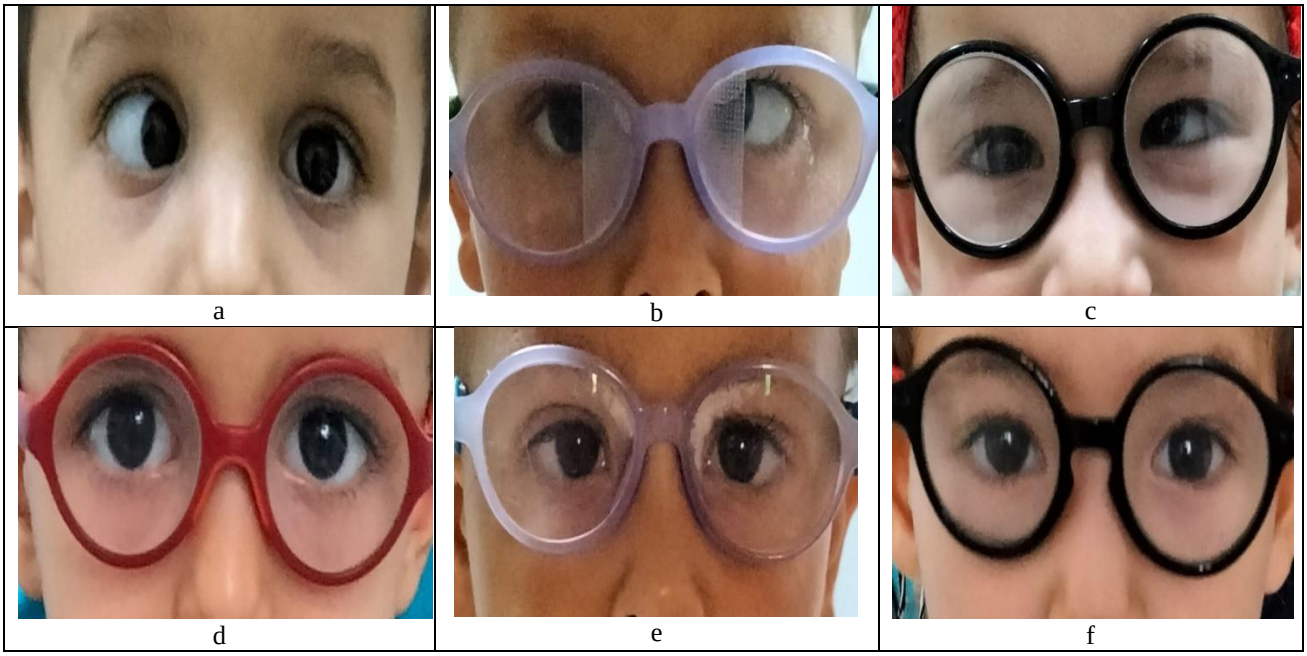

Fig: 3.a-f: the comparison of preoperative and postoperative orthoptic assessments showed improvement starting from 3 months after the injections in all patients; -a,b,c: Before injection; -d,e,f: After injection

DISCUSSION

The injection of botulinum toxin offers an alternative to early surgery, considering the challenges of accurately measuring the angle of deviation and the possibility of spontaneous normalization [2]. With proper medical treatment, 25 to 30% of strabismus cases will decrease over 4 to 5 years or reverse to become divergent, without predictability. According to the ELLISSS study, 20% of early esotropias disappear spontaneously [3]. The PEDIG study estimates that 27% of children with esotropia between 1 and 5 months return to normal by 9 months [4]. The authors have shown that before the age of 4, early surgery has a random component that limits its indication, along with the risks of irreversible consequences that can occur after surgery, not to mention anesthetic difficulties, which allows the toxin to have its full relevance, especially if the initial angle is less than 30 diopters [5, 6].

In reality, no study has yet demonstrated a reduction in the number of secondary interventions after early surgery. The treatment with botulinum toxin certainly presents a better benefit-risk ratio compared to muscle surgery, at the cost of a less aggressive procedure (rapidly reversible anesthesia, outpatient hospitalization, intramuscular injection without muscle sectioning), and without the scarring consequences [7]. A single injection can achieve microtropia in 50% of cases. It also helps to avoid surgery in 60% to 78% of cases, depending on the series [8]. In a study by Ing, 6 out of 12 children demonstrated a deviation of less than 10 prism diopters of orthotropia, and only 3 of these patients showed macroscopic stereopsis [9].

In our series, all patients received a single injection, and a spectacular improvement was noted starting at 3 months (postoperative strabismic deviation less than 10 diopters). Some authors have demonstrated that there is no significant difference in the final strabismic deviation between the treatment of early

esotropia (before the age of 2) with botulinum toxin injection and early muscle surgery for deviation angles of less than 30 diopters [10].

Furthermore, one of the greatest advantages of botulinum toxin treatment is the short duration of the procedure and, consequently, less time required for general anesthesia. In a recent retrospective study comparing surgery and botulinum toxin injections, the mean time for general anesthesia was only 5 minutes for children receiving toxin injections, compared to 71 minutes in the surgery group [11]. In our series, general anesthesia was performed with a laryngeal mask in all children, with an average duration of 10 minutes. Regarding the specific dose of botulinum toxin to inject in early strabismus, there are no recommendations based on the angle of deviation, unlike standardized tables available for muscle surgery [12].

In our series, we injected 20 IU of "Dysport®" in 5 cases with a deviation greater than 20 diopters and 10 IU in one case with a deviation not exceeding 20 diopters. Finally, complications associated with botulinum toxin injections are rare. The most common side effect is an unexpected alignment change due to the migration of the toxin to other extraocular muscles, as well as the development of ptosis if the toxin migrates to the levator muscle of the upper eyelid. These side effects are transient and increase with the injected dose [13]. In our series, we observed the occurrence of bilateral ptosis in 5 out of 6 children (Figure 2) a few days after the injection, which was not obstructive and evolved with regression and disappearance after 3 to 4 weeks.

CONCLUSION

Botulinum toxin is an effective therapeutic tool for infantile esotropia in infants and children, aligning visual axes and allowing for the restoration of normal binocular vision in some cases. It appears to be a less invasive and more conservative alternative compared to muscle surgery.

Conflicts of Interest: There are no conflicts of interest.

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