Comparing Type A Botulinum Toxin and Oropharyngeal Electrostimulation on Sialorrhea in Children with Cerebral Palsy at the Teletón Center for Rehabilitation and Inclusion for Children in the State of Mexico

Comparación de Toxina Botulínica Tipo A y Electroestimulación Orofaringea en Sialorraea en Niños con Parálisis Cerebral En el Centro de Rehabilitación e Inclusión Infantil Teletón Estado de México

Abstract

This work compares two alternative techniques in the treatment of sialorrhea in children with cerebral palsy: botulinum toxin and oropharyngeal electrical stimulation (VitalStim). There were two study groups, one with botulinum toxin type A and the other with oropharyngeal electrical stimulation, and both groups received motor oral therapy. The drooling measurement form from the Department of Plastic and Maxillofacial Surgery of the Royal Children’s Hospital was used, quantifying the amount of saliva by weighing intraoral cotton rolls placed inside the mouth for two minutes.

Statistical analysis was performed using the SPSS-18 packets and the Mann Whitney and Wilcoxon tests. Thirty-two children were included, 16 in the botulinum toxin group (50%) and 16 in the oropharyngeal electrostimulation group (50%). The study showed that the use of botulinum toxin in the salivary glands (parotid and submaxillary) and treatment with oropharyngeal electrostimulation are useful in the treatment of sialorrhea in children with cerebral palsy with a positive impact on the quality of life; however, there was superiority in results with the use of botulinum toxin.
Resumen

Este trabajo compara dos técnicas alternativas en el tratamiento de niños con parálisis cerebral y sialorrea, como lo es la toxina botulínica y la estimulación eléctrica orofaríngea (Vital Stim). Hubo dos grupos de estudio, uno donde se utilizó toxina botulínica tipo A y en el otro estimulación eléctrica orofaríngea, ambos grupos con terapia oral motora; se aplicó el Formulario de medida de babeo del Department of Plastic and Maxillofacial Surgery of the Royal Children’s Hospital, se cuantificó la cantidad de saliva pesando rollos de algodón intraorales colocados dentro de la boca por 2 minutos.

El análisis estadístico se realizó mediante los paquetes de SPSS-18 y las pruebas de Mann Whitney y Wilcoxon. Se incluyeron 32 niños, 16 para el grupo con toxina botulínica (50%) y 16 en el grupo de electroestimulación orofaríngea (50%). El estudio realizado mostró que el uso de toxina botulínica en las glándulas salivales (parótida y submaxilares) y el tratamiento con electroestimulación orofaríngea son útiles en el tratamiento de la sialorrea en niños con parálisis cerebral con un impacto positivo en la calidad de vida, sin embargo hubo superioridad en los resultados con el empleo de la toxina botulínica.

Palabras clave
Toxina botulínica, sialorrea, parálisis cerebral.
Introduction

Sialorrhea is a symptom that generates disability with a multifactorial etiology: neuromuscular/sensory dysfunction, hypersalivation, and anatomical alterations. Within the first is cerebral palsy (CP), a neurological condition prevalent in pediatrics, especially in children with moderate to severe disability, where it can reach up to 58% and become profuse in 33%, the majority of which is spastic quadriplegia.

Physical and psychosocial complications include maceration of the skin around the mouth, secondary bacterial infection, bad smell, dehydration, and social stigmatization. There is also a greater risk of aspiration of saliva, food, or liquid into the lungs, especially when there is deterioration of the gag and cough reflexes. All this has a negative impact on the quality of life of the patient and their family or caregivers.

There is also a deficient mechanism of control of the orofacial, palate, tongue, and head muscles, with aggravating factors such as spasticity, decreased frequency of swallowing, decreased intraoral tactile sensitivity, prolonged protrusion of the tongue, poor dental occlusion, poor head control, and moderate to severe mental retardation.

At rest, 70% of the saliva is produced by the submandibular and sublingual glands. Under stimulation, the flow of saliva increases up to five times, with the parotid gland as the main provider. An adult produces between 1,000-1,500 ml of saliva per day. Children before puberty produce significantly less (750-900 ml per day).

Saliva's functions include mechanical cleaning of the mouth, contribution to oral homeostasis, and pH regulation. It has bacteriostatic and bactericidal properties that contribute to dental health and decrease bad odor. It is important in the lubrication of the food bolus as the amylase it contains starts the digestion of carbohydrates.

Indications for sialorrhea include anticholinergics, tricyclic antidepressants, speech therapy, desensitization techniques, intraoral techniques, elimination of drooling aggravators (such as certain drugs that depress the level of alertness or with muscarinic effect), optimizing the vertical positioning of the head, and achieving the active participation of the subject according to their own cognitive level. In certain cases, surgery is an option.

Intraglandular botulinum toxin type A and oropharyngeal electrostimulation are new treatment options. Several studies have shown the effects are beneficial, very well tolerated, and without reports of significant adverse effects.

The effect of botulinum toxin is temporary and, with oral motor therapy, resembles oropharyngeal electrostimulation.

The aim of the study is to compare the application of botulinum toxin type A and oropharyngeal electrical stimulation in the treatment of moderate to severe sialorrhea in children with cerebral palsy, and their impact on the quality of life of the child and the caregiver.

The sialorrhea form of the Department of Plastic and Maxillofacial Surgery of the Royal Children's Hospital was applied in both groups, using the Thomas-Stonell scale with five severity items and four frequency items, and Likert-type questions.

To measure the salivation as objectively as possible, the amount of saliva was quantified by weighing intraoral cotton rolls.

Material and method

It was a quasi-experimental study carried out from July to October 2014 at the Teletón Children Rehabilitation Center in the State of Mexico of children from 4 to 17 years of age who met the requirements and informed consents of their tutors.

There were two study groups, one with botulinum toxin type A and the other with oropharyngeal...
electrical stimulation. Both groups had oral motor therapy. The botulinum toxin type A dose was 60 units distributed in parotid glands and 40 units sublingual bilaterally.

The electrodes placement used were 1, 3a or 3b according to the manual. The intensity of the stimulus was between 7 and 25 mA, symmetrical biphasic waveforms, a maximum voltage of 100 volts, pulse of 80 Hz, and pulse duration of 700 ms. During the stimulation, the patient practiced swallowing. Ten sessions were prescribed.

In both groups, the clinical assessment was performed by the specialist in pediatric rehabilitation medicine and by the researcher, applying the sialorrhea form of the Department of Plastic and Maxillofacial Surgery of the Royal Children’s Hospital (annex 1). The amount of saliva was quantified by weighing intraoral cotton rolls placed inside the mouth for two minutes. The assessment happened in two stages for both study groups: one at the initial contact and the other in the fourth month of intervention.

This study complied with the Nuremberg Code, the Belmont Report’s ethical principles and guidelines for the protection of human subjects of research, the Declaration of Helsinki’s ethical principles for medical research involving human subjects, the General Health Law regarding health research, and the guidelines and policies of the Teletón Foundation in Mexico.

The statistical analysis was performed with the SPSS-18 program and the Mann Whitney and Wilcoxon tests.

**Figure 1.** Sialorrhea according to type of cerebral palsy and study group.

- **Oropharyngeal electrostimulation group**
- **Botulinum toxin group**

<table>
<thead>
<tr>
<th>Type of Cerebral Palsy</th>
<th>Oropharyngeal Electrostimulation Group</th>
<th>Botulinum Toxin Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed CP</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hypnotic CP</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Dyskinetic CP</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Spastic CP-spastic diplegia</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Spastic CP-spastic hemiplegia</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Spastic CP-spastic quadriplegia</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

n = 32 patients
Results

The study included 32 children, 16 for group A (botulinum toxin type A) and 16 for group B (oropharyngeal electrostimulation). The average age was 9 years for both groups, with a range of 4 to 14 years in group A and 4 to 16 years in group B. Both groups presented a homogeneous distribution regarding number, age, and sex.

Spastic quadriplegia was the most common type of cerebral palsy in both groups. (Figure 1) Table 1 shows that the frequency of sialorrhea decreased after the fourth month of intervention in both groups. Botulinum toxin showed clinical superiority but with no significant statistical difference (p=0.05). Regarding the severity of the sialorrhea, there was a decrease in the averages in both groups; however, there was no statistically significant difference between them (p=0.216). (Figure 2)

<table>
<thead>
<tr>
<th>Frequency of sialorrhea</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>3.69</td>
<td>3.56</td>
</tr>
<tr>
<td>After 4 months</td>
<td>2.13</td>
<td>2.50</td>
</tr>
</tbody>
</table>

n = 32 patients.
Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital (sialorrhea frequency and severity scale measured with Thomas-Stonell scale).19

Table 2 shows that botulinum toxin showed significantly fewer bib changes compared with the oropharyngeal electrostimulation group (p=0.05).

It was reported that there was no significant difference between the study groups (p=0.085) in the variable of changes of clothes per day. (Figure 3)

Table 3 shows that in both groups the degree of discomfort towards the saliva odor decreased: 5.56 points on the Likert scale for the group with botulinum toxin and 2.19 points for the group with oropharyngeal electrostimulation.

Table 4 shows that the intensity of perioral dermatitis had no statistically significant change in the groups (p=0.426).

Table 5 shows a decrease in the average of mouth cleaning frequency in both study groups, but without significance (p=0.075).

Table 6 shows a decrease in the impact on the social affectation of the caregivers at the end of the intervention in both groups, with superiority in group A (botulinum toxin type A).

Figure 4 shows that, according to the Wilcoxon and U Mann Whitney test, botulinum toxin type A shows a statistically significant change in terms of the concern regarding other people’s reaction to the child’s drooling compared to the oropharyngeal electrostimulation group (p=0.038).

Table 7 shows there is no significance in the frequency of saliva cleaning from toys and furniture between the study groups (p=0.135).

Table 8 shows that botulinum toxin type A had a significant decrease in coughing/drowning sensation due to the child’s drooling compared to the oropharyngeal electrostimulation group (p=0.05).
Figure 2. Average severity of sialorrhea by study groups. Thomas-Stonell scale.

Table 2. Average number of changes of bibs per day by study groups.

<table>
<thead>
<tr>
<th>Changes of bibs per day</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>4.81</td>
<td>5.5</td>
</tr>
<tr>
<td>After 4 months</td>
<td>1.75</td>
<td>3.81</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.\(^{19}\)

Figure 3. Average number of changes of clothes per day by study groups.

FSource: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.\(^{19}\)
**Table 3.** Average discomfort at the smell of saliva by study groups.

<table>
<thead>
<tr>
<th>Scale of discomfort at the smell of saliva</th>
<th>Group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>BT type A</td>
<td>8.75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7.38</td>
</tr>
<tr>
<td>After 4 months</td>
<td>3.19</td>
<td>5.19</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

**Table 4.** Average intensity of perioral dermatitis by study groups.

<table>
<thead>
<tr>
<th>Scale of intensity of perioral dermatitis</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>7.69</td>
<td>5.25</td>
</tr>
<tr>
<td>After 4 months</td>
<td>2.88</td>
<td>3.81</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

**Table 5.** Average frequency of mouth cleaning by study groups.

<table>
<thead>
<tr>
<th>Scale of frequency of mouth cleaning</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>9.38</td>
<td>7.63</td>
</tr>
<tr>
<td>After 4 months</td>
<td>3.94</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

**Table 6.** Average social affectation of the child’s constant drooling by study groups.

<table>
<thead>
<tr>
<th>Scale of social affectation by the child’s drooling</th>
<th>Botulinum Toxin Type A</th>
<th>Oropharyngeal electrostimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>6.94</td>
<td>5.5</td>
</tr>
<tr>
<td>After 4 months</td>
<td>2.5</td>
<td>4.13</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19
Figure 4. Average concern about the reaction of other people to the child’s drooling.

![Graph showing concern about reaction to drooling](image)

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

Table 7. Average cleaning of saliva from toys and furniture by study groups.

<table>
<thead>
<tr>
<th>Scale cleaning of saliva from toys and furniture</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>7.25</td>
<td>5.75</td>
</tr>
<tr>
<td>After 4 months</td>
<td>2.75</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

In Table 9, botulinum toxin type A shows a statistically significant change in the decrease in the affectation of drooling in the child’s life and family compared to the oropharyngeal electrostimulation group (p=0.010).

In Figure 5 it was observed that botulinum toxin type A had a statistically significant change in the decrease of drooling on close relatives of the child as compared to the oropharyngeal electrostimulation group (p=0.05).

Table 10 shows that botulinum toxin type A had significance in the weight reduction of intraoral cotton (p=0.002).

Table 8. Average drooling necessary to provoke coughing or drowning by study groups.

<table>
<thead>
<tr>
<th>Scale of drooling necessary to provoke coughing or drowning</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>4.38</td>
<td>4</td>
</tr>
<tr>
<td>After 4 months</td>
<td>1.69</td>
<td>2.56</td>
</tr>
</tbody>
</table>

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19
Table 9. Average affectation of the life of the child and the family due to drooling by study groups.

<table>
<thead>
<tr>
<th></th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>7.94</td>
<td>6</td>
</tr>
<tr>
<td>After 4 months</td>
<td>2.69</td>
<td>4.06</td>
</tr>
</tbody>
</table>

*Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

Figure 5. Average drooling on close relatives by study groups.

Source: Sialorrhea measurement form from the Department of Plastic and Maxillofacial Surgery, Royal Children’s Hospital.19

Tabla 10. Average weight of intraoral cotton by study groups.

<table>
<thead>
<tr>
<th>Weight of intraoral cotton</th>
<th>Botulinum toxin type A group</th>
<th>Oropharyngeal electrostimulation group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning</td>
<td>23.125*</td>
<td>21*</td>
</tr>
<tr>
<td>After 4 months</td>
<td>14.81*</td>
<td>17*</td>
</tr>
</tbody>
</table>

*weight in decigrams

Source: Reid SM, Johnstone MB. Randomized trial of botulinum toxin injections into the salivary glands to reduce drooling in children with neurological disorders. Developmental Medicine and Child Neurology; Feb 2008; 50,2; ProQuest Hospital Collection pg 123-128.11
Discussion

According to Tahmassebi in Prevalence of Drooling in Children with Cerebral Palsy Attending Special Schools, sialorrhea is a prevalent symptom in cerebral palsy that is barely considered and difficult to treat, yet with a negative impact on the quality of life of the patient, the family, and/or the caregivers.

According to Banerjee, sialorrhea can occur in up to a third of children with cerebral palsy, particularly the moderate and severe types, and most frequently in spastic quadriplegia, which correlates with our study. The objective of his study was to determine if the injection of botulinum toxin in the parotid and submandibular glands in children between 6 and 16 years decreased salivation and improved their quality of life. He reported that the frequency of sialorrhea and the severity scores had a statistically significant decrease at four weeks (p<0.001) and at 12 weeks (p<0.006), improving the quality of life of the child and the family. These findings are confirmed in our study.

According to Reid, in a randomized study, Peter and Benson mentioned that children with sialorrhea have different secondary problems, such as odor, dermatitis, cough, and presence of saliva in toys, computers, clothes, etc, causing social isolation in school and even with their family. They reported the effectiveness in reduction of these discomforts with a significant difference after six months of application. These studies support the results of our study.

Alferai and Dressler concluded that botulinum toxin is effective in the treatment of sialorrhea adding that there were some children who did not respond to the first infiltration but improved after the second. In our study, only one infiltration was contemplated, observing a better result in severe sialorrhea compared to the response to oropharyngeal stimulation.

There are no studies comparing the efficacy of botulinum toxin and oropharyngeal electrostimulation. The research of Madrigal and various studies in the Manual of Oropharyngeal Electrostimulation report an improvement in drooling secondary to the treatment. This research work has also shown an improvement of this picture.

When studying the quality of life, our study took into account the variable of drooling on nearby objects. Zeppa and the systematic review by Benson and Daugherty report botulinum toxin improves this aspect, corroborating the result of our study. There is no research on this variable in similar studies with oropharyngeal electrostimulation.

In general, according to the results obtained in this research, both botulinum toxin type A and oropharyngeal electrostimulation are minimally invasive alternatives for the treatment of moderate to severe sialorrhea in pediatric patients with cerebral palsy, which has a positive impact on the quality of life of the patient and the caregivers.

No adverse effects were observed during the procedure of the application of botulinum toxin type A or oropharyngeal electrostimulation.
Conclusions

This study shows that the use of botulinum toxin in the salivary glands (parotid and submaxillary) and the treatment with oropharyngeal electrostimulation are useful in the treatment of sialorrhea in children with cerebral palsy with a positive impact on the quality of life, and there was superiority in the results with the use of botulinum toxin.

Conflicts of interest
We declare that this research has no conflicts of interest.

Funding
No funding was received for the realization of this work.
References


