TREATING SEVERE BRUXISM WITH BOTULINUM TOXIN

ENG-KING TAN, M.D.; JOSEPH JANKOVIC, M.D.

ABSTRACT

Background. Locally administered botulinum toxin, or BTX, is an effective treatment for various movement disorders. Its usefulness in treating bruxism, however, has not been systematically evaluated.

Subjects and Methods. The authors studied 18 subjects with severe bruxism and whose mean duration of symptoms was 14.8 ± 10.0 years (range three-40 years). These subjects audibly ground their teeth and experienced tooth wear and difficulty speaking, swallowing or chewing. Medical or dental procedures had failed to alleviate their symptoms. The authors administered a total of 241 injections of BTX type A, or BTX A, in the subjects' masseter muscles during 123 treatment visits. The mean dose of the BTX A was 61.7 ± 11.1 mouse units, or MU (range 25-100 MU), per side for the masseter muscles.

Results. The mean total duration of response was 19.1 ± 17.0 weeks (range six-78 weeks), and the mean peak effect on a scale of 0 to 4, in which 4 is equal to total abolishment of grinding, was 3.4 ± 0.9. Only one subject (5.6 percent) reported having experienced dysphagia with BTX A.

Conclusion. The results of this study suggest that BTX administered by skilled practitioners is a safe and effective treatment for people with severe bruxism, particularly those with associated movement disorders. It should be considered only for those patients refractory to conventional therapy. Future placebo-controlled studies may be useful in further evaluating the potential of BTX in the treatment of bruxism.

Bruxism is a diurnal or nocturnal parafunctional activity that includes tooth clenching, bracing, gnashing and grinding.[1] Its prevalence rates range from 5 to 96 percent in the adult population.[2-5] Differences in the methodology and the definitions of bruxism used in different studies contribute to the varied reported prevalence rates.

Bruxism is of great interest to dentists, oral surgeons, psychologists, neurologists, primary care physicians and others who provide treatment. Although many etiologic factors such as stress and occlusal disorders have been proposed,[2,6-7] bruxism's exact pathophysiology still is unknown.

Bruxism has been reported in certain neurological disorders such as Rett syndrome,[8] mental retardation,[9] anoxic encephalopathy[10] and cerebellar hemorrhage.[11] Tooth clenching, grinding or both have been reported to be particularly prevalent in patients with idiopathic, tardive and posttraumatic cranial dystonia, which is a neurological disorder manifested by abnormal spasms and movements involving the orolingual-facial musculature.[12-14] The majority of these patients had diurnal symptoms, though some had both diurnal and nocturnal symptoms.[12] These symptoms appear to be different than those of subjects with nocturnal grinding frequently reported in the dental literature.

Various treatment modalities have been reported to be useful for bruxism,[2,15-20] but there is no

general agreement as to what is the best therapeutic option.

Botulinum toxin, or BTX, is the most potent known biological toxin and is a safe and effective for treatment of various forms of neurological disorders.[21,22] Training guidelines have been established for the use of BTX.[23-25] This neurotoxin is produced by the anaerobic bacterium *Clostridium botulinum* and exerts its paralytic effects by inhibiting the release of acetylcholine at the neuromuscular junction. The toxin is a zinc endopeptidase that cleaves one or more proteins in the docking of the acetylcholine with the presynaptic membrane, thus inhibiting the release of the acetycholine into the neuromuscular junction. This results in local chemodenervation and focal muscle weakness.

Seven antigenically distinct types of BTX have been recognized: A, B, C, D, E, F and G. Type A, which cleaves the plasma protein SNAP-25, is the most common commercially used type of BTX, but clinical experience with types B, C and F is increasing.[26]

BTX is administered by intramuscular injection, and its effects last an average of three to six months. The extent of this transient denervation is dependent on the dose and volume of the toxin.

The unit of measurement for BTX type A, or BTX A, is the mouse unit, or MU. One MU is equivalent to the amount of toxin found to kill 50 percent of a group of 18- to 20-gram female Swiss Webster mice. The usual maximum recommended dose is 300 to 400 MU per session and not more than 400 MU per three-month period. The dose, however, varies depending on the size of the target muscle, the intensity of contraction and other factors such as response to the initial treatment.

To date, no anaphylaxis or deaths attributable to BTX A have been reported. BTX is contraindicated in patients with neuromuscular disease, who are receiving aminoglycosides or who are pregnant or lactating. Long-term effects of BTX are mild and may include alterations in muscle fiber size.[27]

No known reports exist on quantified results; however, there have been a few anecdotal reports demonstrating the effectiveness of BTX in patients with bruxism.[28-30]

In an open-label prospective study, we evaluated the effectiveness and complications of BTX A (BOTOX, Allergan Inc.) treatment in patients with severe bruxism. These patients' bruxism was manifested by diurnal or nocturnal tooth grinding, and a majority of them had associated movement disorders.

SUBJECTS AND METHODS

We included in the study patients who were evaluated at Baylor College of Medicine's Parkinson's Disease Center and Movement Disorders Clinic over an eight-year period, who complained of teeth clenching and grinding as their predominant symptoms, and who satisfied the following diagnostic criteria: tooth-grinding sounds corroborated by family members or caregivers; difficulty in chewing, swallowing or speech; tooth wear; receipt of medical therapies and dental procedures that failed to alleviate bruxism; and pain or hypertrophy of masseter muscles from palpation during a clinical examination. In addition to the diagnosis of bruxism, we required at least one follow-up evaluation after BTX treatment. We excluded patients with histories of severe trauma to the jaw, dental surgeries or both that preceded their bruxism, as we were not sure whether the procedures were performed to treat the bruxism or for other reasons such as to treat trauma.

A total of 18 subjects, 17 of whom were women, met our criteria to participate in the study. Their mean age was 50.6 ± 20.7 years (range 18-80 years), and the average time they had experienced bruxism was 14.8 ± 10.0 years (range three-40 years). The mean duration of follow-up was 3.3 ± 2.8 years (range 0.4-eight years). All of the subjects had diurnal or nocturnal tooth grinding or both, but the majority had predominant diurnal symptoms. The most common associated movement disorder was dystonia (Table 1).

Before we administered BTX injections, the subjects were required to sign a written informed consent form that had been approved by Baylor College of Medicine's Institutional Review Boards for Human Research.

We placed each subject in the supine position, localized the muscles by careful palpation and then injected BTX A in the masseter muscles—the active muscles that caused the grinding—at two to three sites. We administered a total of 241 BTX A injections in the subjects' masseter muscles during 123 treatment visits—121 injections in the right masseter muscles and 120 injections in the left masseter muscles. The mean dose of BTX A was 61.7 ± 11.1 MU (range 25-100 MU) per side for the masseter

muscles. (The formulation and preparation of BTX A have been described previously.[21]) The mean time interval between BTX A treatments was 5.0 ± 1.8 months (range 3.2-9.7 months).

We also administered BTX A injections in the relevant muscles of 14 subjects who had evidence of associated dystonia—a clinical diagnosis defined as muscle spasm resulting in abnormal posturing—in other anatomical regions (face, neck, and arms and legs) on clinical examination.

We defined latency of response of BTX A's effect as the number of days between the injection and the first sign of improvement after the injection. We defined peak effect as the maximum benefit obtained from the injection; it was rated on a scale of 0 to 4 (0 = no effect, 1 = mild improvement, 2 = moderate improvement but no change in function, 3 = moderate improvement in severity and function, and 4 = marked improvement in severity and function). We determined each subject's peak effect after a careful review of his or her daily diary (a self-assessment of severity of symptoms) and own perception of response, as well as interviewing his or her spouses and friends. We defined the maximum duration of response as the number of weeks during which the subjects experienced peak effect and defined total duration of response as the entire period after the injection was administered during which subjects experienced any improvement.

We collected the following information and entered it into a database:

- demographic data;
- etiology of bruxism;
- duration of bruxism;
- associated dystonia or movement disorders in other body parts;
- family history of bruxism or movement disorders;
- site and number of BTX A injections;
- mean and cumulative muscle dose;
- number of treatment visits;
- number of subjects and treatment visits with complications;
- types, duration and severity of complications;
- response to BTX—measured by peak effect—latency to response and maximum and total duration of response.

RESULTS

The subjects' mean latency to response was 2.7 ± 1.7 days (range 0.5-five days). Their mean maximum and total duration of response were 11.7 ± 4.1 weeks (range 2.5-18 weeks) and 19.1 ± 17 weeks (range six-78 weeks), respectively. The mean peak effect of BTX was 3.4 ± 0.9 (range 0-4).

Only one subject (5.6 percent) reported experiencing an adverse effect—dysphagia—with BTX A, and some adverse effects were noted at six of the 123 treatment visits (4.9 percent). The mean duration of complications was 34.7 ± 7.0 days (range 21-40 days).

CASE REPORTS

Case 1. A 79-year-old woman with a long history of bipolar disorder came to Baylor College of Medicine's Parkinson's Disease Center and Movement Disorders Clinic because she walked slowly and had abnormal mouth and tongue movements. In addition, she complained of experiencing severe tooth grinding for three years. The audible grinding sounds that occurred day and night regularly disturbed her family members. She experienced severe tooth wear, particularly on her mandibular teeth, and underwent various dental procedures, including insertion of dentures. This treatment temporarily alleviated her grinding, but the relief did not last. Her speech and swallowing were affected by the severe grinding. She had been prescribed various pharmacological therapies by her physicians but had not experienced any relief.

When we examined her, we noted that she had mild parkinsonian symptoms and a symptomatic shuffling gait, as well as stereotypical movements of her tongue and mouth. Audible tooth-grinding sounds were noted at the time of examination. She also had jaw tenderness and bilateral masseter muscle spasms on clinical palpation. Although she was diagnosed with early Parkinson's disease, her parkinsonism and severe bruxism were likely secondary to neuroleptic usage, as she had a history of exposure to neuroleptics for treatment of her bipolar disorder, and she had tongue and mouth movement suggestive of tardive dyskinesia.

We injected 60 MU of BTX A in each of both masseter muscles, as well as 10 MU of BTX in the submentalis muscle because of presence of a mild spasm in this muscle.

She reported improvement of her grinding within few days, and it gradually stopped one month after the injection. Her jaw pain also resolved, and she was able to speak and swallow without problems. She did not

TABLE 1

FEATURES IN SUBJECTS WITH BRUXISM.

FEATURE	NUMBER	PERCENTAGE
Etiology		
Idiopathic	7	38.9
Tardive (drug-induced)	4	22.2
Postanoxia	3	16.7
Neurodegenerative	3	16.7
Head trauma	1	5.5
Associated Movement Disorder		
Dystonia	9	50.0
Chorea	3	16.7
Parkinsonism	2	11.1
None	4	22.2
Dental Procedure		
Dentures	5	27.8
Temporomandibular surgery	4	22.2
Bridging	3	10.7
Others	6	33.3

receive any further BTX A injections. At one and one-half years after she received BTX A treatment, her grinding did not recur, though there were a few episodes of tooth clenching.

Case 2. We examined a 19-year-old woman with cerebral palsy and seizures secondary to perinatal anoxia at the clinic. Abnormal muscle spasms in her face, neck, and arm and leg muscles had developed by time she was two years of age. She had experienced tooth wear resulting in broken teeth that had been restored. Her evaluation stemmed from grinding that was mostly intermittent, though there were occasions when she would grind continuously throughout the day. Her parents had noticed audible tooth-grinding sounds predominantly during the day.

When we examined her, we found the presence of eyelid muscles spasms (blepharospasm) and mild neck and limb muscles spasms, and heard grinding sounds. She had jaw tenderness and bilateral masseter muscle spasms on clinical palpation.

We injected 50 MU of BTX in each of both masseter muscles, as well as 30 MUs of BTX in her eyelid and brow muscles.

Her parents reported that her grinding improved by at least 75 percent within a day of the injection. The improvement had lasted for four months.

DISCUSSION

While no central nervous system structures associated with teeth grinding have been identified, it has been speculated that, in some cases, bruxism may be a part of dystonia and share similar pathophysiology.[12] A higher prevalence rate of bruxism has been reported in cranial-cervical dystonia compared with normal controls.[12] Patients with neurological disorders such as Rett syndrome and anoxic encephalopathy or who are in a comatose state might have more severe bruxism.

It has been postulated that the activation of phasic jaw activity depends on the interaction among the motor, limbic and autonomic systems, resulting in either disinhibition or facilitation of a "central bruxism generator."[31] There is evidence of anatomical connections between the limbic system, pontine reticular formation and the trigeminal motor nucleus.[32]

How a single dose of BTX A injection in the masseter muscles totally abolishes severe bruxing behavior, as illustrated

TABLE 2

TREATMENT, RESPONSE AND COMPLICATIONS OF BOTULINUM TOXIN TYPE A.

FACTOR	RESULT
Total Number of Subjects/Treatment Visits	18/123
Total Number of Masseter Injections (Right/Left)	121/120
Mean Botulinum Toxin Dose (Mouse Units)	61.7 ± 11.1 (range 25-100)
Mean Interval Between Injections (Months)	5.0 ± 1.8 (range 3.2-9.7)
Mean Maximum Duration of Response (Weeks)	11.7 ± 4.1 (range 2.5-17)
Mean Total Duration of Response (Weeks)	19.1 ± 17.0 (range six-78)
Mean Latency of Response (Days)	2.7 ± 1.7 (range 0.5-five)
Mean Peak Effect	3.4 ± 0.9 (range 0-4)
Percentage of Complications (Subjects/Treatment Visits)	5.6/4.9

in our first case report, is intriguing. There also has been a reported case of total resolution of bruxism—caused by a brain injury—after a single injection of BTX.[28] We speculate that jaw muscle paralysis induced by BTX A may disrupt the feedback loop from the trigeminal motor nucleus and inhibit the central bruxism generator. Alternatively, it also may deactivate periodontal mechanoreceptors during mastication, which have been thought to have a facilitatory effect on jaw closure motoneurons.[33]

CONCLUSIONS

This study of 18 subjects with severe bruxism provides evidence that BTX A administered appropriately into the masseter muscles is a safe and effective treatment for this condition.

The subjects had experienced their symptoms for a mean of 14.8 years before the initial injection. Before BTX A treatment, the subjects' bruxism had failed to respond to various medical therapies and dental procedures, providing further evidence of its severity (Table 1). Marked relief of grinding and functional improvement in chewing, swallowing or speaking was reported in 16 subjects (88.9 percent) after BTX A treatment. The mean latency to response of action of BTX was relatively short (2.7 days) in our subjects, and the total effect of each injection lasted up to a mean of 19.1 weeks (Table 2). On the average, subjects needed BTX A injections at a regular interval of five months; each time a mean dose of about 62 MU per side was injected in the masseter muscles. This dose was, on average, higher than the treatment we gave to patients with jaw closing dystonia in a previous study.[21] We did not administer BTX A in the temporalis muscles of our subjects and do not know if this would have further improved the results.

The treatment complication rate was low. Only one subject (5.6 percent) reported experiencing transient dysphagia, which did not require change of diet after we injected the BTX A. This complication constituted only six of the 123 treatment visits (4.9 percent) in the study. The complication rate was comparable to that of patients with dystonia treated with BTX in our previous study.[21]

A chief difficulty in assessing the severity of bruxism and a response to therapy is the lack of consensus on the definition of bruxism; a validated severity scale is not available. Based on various criteria used in the literature,[20] we had defined severe bruxism in those with daily audible teeth grinding as corroborated by family members or caregivers.

All of the subjects in the study were partially disabled by the bruxism because of impaired chewing, swallowing or speaking; tooth wear; and temporomandibular joint tenderness or hypertrophy of the masseter muscles on palpation. While this study has shown that BTX A is effective for treating severe bruxism, it must be pointed out that our subjects appear to be more affected by bruxism than patients with nocturnal symptoms who are frequently encountered in a dental practice. Most of the subjects in this study had associated diurnal movement disorders such as dystonia.

In summary, our study of a select group of subjects (the majority of whom had associated movement disorders) has demonstrated that BTX A injections can be a safe and effective treatment for severe tooth grinding. It is, however, an expensive treatment and should be considered as a therapeutic option only for those who have complicated or disabling bruxism and are refractory to other medical and dental therapy. BTX A should be administered only by clinicians with knowledge of its pharmacology and the relevant anatomy of the sites to be injected. Experience and skill in the techniques of injections will minimize the risk of unnecessary complications. Future placebo-controlled studies may be useful to further evaluate the potential of BTX A treatment in bruxism. ■

Dr. Tan is a visiting fellow, Parkinson's Disease Center and Movement Disorders Clinic, Department of Neurology, Baylor College of Medicine, Houston. He also is an associate consultant, SGH Brain Center, Department of Neurology, Singapore General Hospital.

Dr. Jankovic is a professor and the director, Parkinson's Disease Center and Movement Disorders Clinic, Department of Neurology, Baylor College of Medicine, 6550 Fannin Smith 1801, Houston, Texas 77030. Address reprint requests to Dr. Jankovic.

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