A systematic review of botulinum toxin in the management of patients with temporomandibular disorders and bruxism

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Key points

- Describes how the use of botulinum toxin in the management of TMD and bruxism is becoming more widespread.
- Suggests the current evidence is positive and indicates there is potentially a place for botulinum toxin in the management of these conditions.
- Highlights primary conservative options such as self-management with explanation should be exhausted first, before botulinum toxin is considered.

Abstract

Introduction The medical and cosmetic use of botulinum toxin (BTX) is now widespread. With an increased number of clinicians adopting the use of BTX in the management of temporomandibular disorders (TMD) and/or bruxism, as either a standalone treatment or as an adjunct, affirmation is required in regards to whether it has a clinically justifiable position among the current spectrum of available treatment modalities.

Objectives To establish the usefulness of BTX when treating patients with TMD and/or bruxism, and thereby determine whether there may be an appropriate purpose for the prescription of BTX in the management of these patients.

Data sources and data selection A systematic review of the relevant literature was conducted. The literature search was carried out by applying key terms to appropriate data sources (Medline, Embase, Pubmed, Cochrane Central Register of Controlled Trials, and OpenSIGLE). The resultant papers were subjected to inclusion and exclusion criteria, which were then assessed for bias using a framework outlined in the Cochrane Handbook.

Results A total of 11 trials met the inclusion criteria. The primary outcome measure was changes in pain experience in groups that had been treated with BTX, relative to an appropriate control group. Secondary outcomes included changes in the frequency of bruxism events, changes in maximum mouth opening, changes in occlusal force and changes in electromyography (EMG) readings of muscles of mastication.

Conclusion The evidence to support the use of BTX in the management of TMD and/or bruxism is not entirely unequivocal. A number of studies that have met the inclusion criteria have shown promising results and thereby justify further investigation. Given the current evidence, BTX should certainly be considered but due to financial implications and possible side effects, it seems appropriate that conservative options, such as self-management with explanation and physical therapies, should be exhausted first.

Introduction

Temporomandibular disorders (TMD) have been described by the American Association for Dental Research (AADR) as 'a group of musculoskeletal and neuromuscular conditions that involve the temporomandibular joints (TMJ), the masticatory muscles, and all associated tissues'.[1] It is believed to be the most common cause of chronic pain in the orofacial region, and third overall after headache and backache.[2] TMD encompasses a broad range of disorders and, as there are various classifications in use, it is difficult to assess its prevalence accurately, although it is thought to be in the region of 10–30%.[3,4]

The aetiology is multifactorial, and it is considered that biopsychosocial factors, including genetics and psychological characteristics, as well as parafunction, occlusion and trauma, have possible roles.[2] Of the parafunctions, bruxism is the most common[5] and the relationship between bruxism and TMD, despite in some cases being weak, has been widely described.[5,6,7,8] Bruxism is described as:

'A repetitive jaw-muscle activity characterised by the clenching or grinding of the teeth and/or by bracing or thrusting of the mandible. Bruxism has two clear circadian manifestations: it can occur during wakefulness (indicated as awake bruxism) or during sleep (indicated as sleep bruxism)'.[9]

It is estimated that 24% and 16% of the adult population suffer from awake and nocturnal bruxism, respectively.[10] It is thought by the World Health Organization (WHO) that there is a large psychogenic component in the

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Refereed Paper.
Accepted 6 December 2018
DOI:10.1038/s41415-019-0257-z

aetiology of bruxism,[5] with increased muscles of mastication activity and possible associated pain being common.[11] Similarly, patients with TMD may present with myogenous clinical manifestations[12] and this plays a significant role in Axis I, one of the most commonly used classifications for TMD, the research diagnostic criteria for TMD (RDC/TMD).[5,13] Despite the pathophysiological and aetiological complexities involved in TMD and bruxism, a commonality between the two conditions is their potential myogenic involvement resulting in the presentation of clinical signs and symptoms.

Methods of management for TMD and bruxism

Over the years there has been a shift in consensual views regarding the management approach for treatment of TMD and/or bruxism. Previously, there was a tendency to consider invasive dental procedures or surgery, whereas now a greater emphasis is placed on dealing with psychosocial/social factors.[14,15] When dental intervention is required, it is kept as conservative as possible and can often involve the use of a full coverage stabilisation splint (Box 1).

A Cochrane review, analysing trials up until June 2001, showed weak evidence to suggest that stabilisation splints may be beneficial in reducing pain in the TMJ against minimal or no treatment.[16] In addition, with removable appliances the matter of compliance becomes a factor that can make treatment outcomes unpredictable.[17] A Swedish study in 2012 attempted to demonstrate patient adherence to hard acrylic interocclusal appliance treatment. A response from their questionnaire sent to 457 patients showed 73% and 54% used their appliance 1–1.5 years after they had received them from general practice and specialist practice, respectively.[18] One of the most common reasons for not using the appliance was shown to be comfort related. Non-compliance has been estimated to be between 30–60% for non-therapeutic regimens,[19] and a study by Wig *et al.* (2004) to assess patient compliance with temporomandibular disorder treatment recommendations over two weeks, showed a median rate of only 54.8%.[20]

Current uses of botulinum toxin

Botulinum toxin is a safe primary treatment choice for cervical dystonia and also an option for various other muscle-related disorders, including blepharospasm and hemifacial spasm.[21] The cosmetic use of BTX is becoming ever more common in the treatment of facial rhytides, where there is strong evidence to show its effectiveness against a placebo, without severe complications.[22] BTX is injected intramuscularly and acts on presynaptic cholinergic nerve terminals by blocking the release of acetylcholine, resulting in relaxation of the muscle until the sprouting of new synaptic connections occurs.[23] In addition, BTX is shown to block the release of inflammatory mediators, such as substance P and glutamate, creating an antinociceptive effect.[24,25] These muscle relaxing and analgesic properties, as well as a reduction in issues relating to compliance, have seen an increase in the number of clinicians using BTX as a treatment modality for myogenous TMD and/or bruxism.

Box 1 Reversible therapies used in the management of patients with TMD

Self-management with explanation (reassurance, counseling, basic adjustments to everyday life)[2]

Physical therapies (for example, postural exercises and simple home physiotherapeutic exercises)

Pharmacotherapy (for example, non-steroidal anti-inflammatory drugs)

Occlusal splint therapy (for example, stabilisation splint)

Pyschological interventions (for example, cognitive behavioural therapy)

Application of botulinum toxin to the muscles of mastication

Box 2 Eligibility criteria applied to papers that were yielded from the searches

Inclusion criteria

The types of participants included were to be of any age, sex, race or educational status. They must have TMD of myogenous nature and/or bruxism – the diagnoses did not have to follow specific diagnostic criteria in order to be accepted

Types of interventions to be permitted included placebo or no treatment (inactive control interventions), oral splints, facial manipulation, laser, conservative treatment (active control interventions) and only botulinum toxin could be used as the test intervention

The primary outcome to be considered was changes in pain. Secondary outcomes included changes in the frequency of bruxism events, changes in maximum mouth opening, changes in occlusal force and changes in EMG readings of muscles of mastication

Randomised (cluster and individual) and non-randomised control studies were to be included[26]

Exclusion criteria

Bruxism caused by other disorders (brain injury, medications, unrelated systemic diseases such as Huntington's, cerebral palsy, autism, multiple sclerosis)

BTX therapy aimed at treatment of other diseases

Objective

This systematic review concentrates on determining the usefulness of BTX when treating patients with TMD and/or bruxism to establish whether there may be an appropriate rationale for the prescription of BTX in the management of these patients.

Method

A literature search was carried out by applying key terms, including and relating to botulinum toxin, to appropriate data sources (Medline [MeSH] via OVID, Embase via OVID, Pubmed, Cochrane Central Register of Controlled Trials, and OpenSIGLE). These terms included ('Botulinum toxin' [MeSH] or 'Botox' or 'Botulinum') with relevance to: terms including and relating to temporomandibular disorders ('TMD' or 'Temporomandibular Disorder' or 'Temporomandibular Joint Disorders' [MeSH] or 'Temporomandibular pain dysfunction syndrome' or 'Myofacial pain' or 'Temporomandibular' or 'Temporomandibular Joint Dysfunction Syndrome' [MeSH] or 'Facial Pain' [MeSH] or 'Face Pain') and/or terms including and relating to bruxism ('Bruxism' [MeSH] or 'parafunction' or 'tooth grinding' or 'tooth clenching' or 'bruxist'). These search terms were applied to search dates selected from inception to 15 July 2018. The results were then subjected to the eligibility criteria (Box 2).

Results

After duplicates were removed, a total of 306 results were yielded which were subsequently subjected to the eligibility criteria (Box 2). This left 11 results that were deemed appropriate for risk of bias analysis (Table 1) and for data collection (Table 2).

Table 1 The risk of bias for the included papers, using guidance from the Cochrane Handbook

	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Guarda-Nardini *et al.*[27]	Risk: low	Risk: high	Risk: high	Risk: high	Risk: low	Risk: low	Risk: n/a
Ernberg *et al.*[28]	Risk: low	Risk: low	Risk: low	Risk: unclear	Risk: high	Risk: low	Risk: n/a
Von Lindern *et al.*[29]	Risk: unclear	Risk: unclear	Risk: high	Risk: low	Risk: high	Risk: high	Risk: unclear
Kurtoglu *et al.*[30]	Risk: low	Risk: unclear	Risk: low	Risk: low	Risk: low	Risk: low	Risk: n/a
Nixdorf *et al.*[31]	Risk: low	Risk: low	Risk: low	Risk: unclear	Risk: high	Risk: low	Risk: n/a
Guarda-Nardini *et al.*[32]	Risk: unclear	Risk: unclear	Risk: low	Risk: unclear	Risk: unclear	Risk: unclear	Risk: n/a
Lee *et al.*[33]	Risk: unclear	Risk: unclear	Risk: low	Risk: unclear	Risk: low	Risk: low	Risk: n/a
De Carli *et al.*[34]	Risk: low	Risk: high	Risk: high	Risk: high	Risk: high	Risk: unclear	Risk: n/a
Zhang *et al.*[35]	Risk: unclear	Risk: unclear	Risk: unclear	Risk: unclear	Risk: low	Risk: low	Risk: n/a
Chaurand *et al.*[36]	Risk: high	Risk: high	Risk: high	Risk: high	Risk: high	Risk: unclear	Risk: n/a
Patel *et al.*[37]	Risk: low	Risk: low	Risk: unclear	Risk: unclear	Risk: high	Risk: low	Risk: n/a

Table 2 A summary of the results from the 11 papers that met the eligibility criteria

Study	Size of sample (test/ control)	Test/ control	Diagnosis	Primary Outcome measure	Results summary	Secondary outcome measures	Result summary
Guarda-Nardini *et al.*[27]	15/15	T = BTX C = fascial manipulation technique	TMD (myofascial pain)	Pain VAS (0–10)	Baseline: C = 6.0 T = 7.3 Immediate post-op: C = 2.1 T = 5.2 3 months: C = 2.5 T = 4.8	Maximum mouth opening	Increase from baseline to 3 months: C = 0.44 mm T = 2.7 mm
Ernberg *et al.*[28]	21/21	T = BTX C = isotonic saline	TMD (myofascial pain)	Pain VAS (0–100 mm)	Mean results, baseline: C = 54 T = 58 1 month: C = 11% T = 30% (to baseline) 3 months: C = 4% T = 23% (to baseline)	Maximum mouth opening	Increase from baseline to 1/3 months: C = 0.9 mm / 0.1 mm T = 1.6 mm / 1.6 mm
Von Lindern *et al.*[29]	60/30	T = BTX, C = saline	TMD (myofascial pain) and bruxism	Pain VAS (0–10), there was no raw data present	Baseline, 4 week C = 0.4 improvement, T = 3.2 improvement	n/a	
Kurtoglu *et al.*[30]	12/12	T = BTX, C = saline	TMD (myofascial pain)	RDC/TMD axis II biobehavioural questionnaire Q7–9 (relates to pain)	Baseline: C = 58.9 T = 56.1 14 days: C = 51.1 T = 45.8 28 days: C = 51.4 T = 43.9	EMG readings at rest and maximal clenching, of the anterior temporal muscles and masseters bilaterally	Calculated mean EMG (for temporalis and masseters bilaterally) when rest/clenching (mV). Baseline: C = 200.0/529.3 T = 206.3/296.0 14 days: C = 252.3/498.8 T = 165.0/199.0 28 days: C = 212.8/540.8 T = 221.0/256.0 (note: these have been calculated from the data presented in the paper)
Nixdorf *et al.*[31]	15/15	T = BTX, C = saline	TMD (RDC/TMD – group I.a. and II.b. or myofascial pain without and with limited mouth opening)	Pain VAS (0–100 mm) there was no raw data present	Baseline, 8 weeks: mean difference in VAS 1) Pain intensity C = 1 mm reduction, T = 19 mm reduction 2) Pain unpleasantness C = 5 mm, T = 13 mm reduction	Maximum mouth opening (with and without pain)	Maximum opening with/without pain: increase from baseline to 8 weeks (mm): C = 5/10, T = 3/0
Guarda-Nardini *et al.*[32]	10/10	T = BTX, C = saline	TMD – RDC/TMD – group I.a. and II.b. bruxism	Pain VAS (0–10)	Baseline: C = 4.1 T = 6.2 1 week: C = 3.8 T = 5.2 1 month: C = 3.7 T = 3.6 6 months: C = 4.7 T = 3.6	Maximum mouth opening (non-assisted and assisted)	Maximum opening (non-assisted and assisted), increase from baseline to 6 months (mm): C = 2.1 and 1.8, T = 0.3 and 1.0
Lee *et al.*[33]	6/6	T = BTX, dysport C = saline	Bruxism	N/A	N/A	Bruxism events during sleep	Number of EMG bruxism events per hour during sleep (using the 20% MVC criterion) at baseline/4/8/12 weeks C = (2.48 ± 1.26) / (2.24±1.06) / (2.50 ± 1.37) / (2.66±1.44) T = (2.77±1.86) / (0.15±0.29) / (0.26±0.35) / (0.26 ± 0.24)

Table 2 A summary of the results from the 11 papers that met the eligibility criteria (cont.)

Study	Size of sample (test/ control)	Test/ control	Diagnosis	Primary Outcome measure	Results summary	Secondary outcome measures	Result summary
Carli *et al.*[34]	7/8 (this excludes the three drop outs)	T = BTX C = low level laser	Myofacial pain	Pain (VAS)	Baseline: C = 7 (approx.), T = 7 (approx.) Day 30: C = 3.5 (approx.), T = just under 3.5 (approx.)	Mouth opening	Baseline = C = 42 (approx.), T = 38 (approx.) Day 30 = C = 42 (approx.), T = 36 (approx.)
Zhang *et al.*[35]	10/10/10 (two controls used)	T = BTX C1 = saline C2 = no treatment	TMD and bruxism or daytime clenching for >2/12	n/a	n/a	Occlusal force	Changes in mean (SEM) maximum bite force (kg) from baseline to 1/3/6 months: C1: 7.97/13.33/22.52 C2: 0.94/8.63/3.77 T: 41.97/48.17/39.79
Chaurand *et al.*[36]	11/11 (same participants acting as control and test)	T = BTX C = conservative treatment	TMD (myofacial pain) (RDC/TMD)	Pain (VAS)	Baseline: C and T = 8.48 1 month: C = 5.2% reduction, T = 19.2% reduction	Maximum mouth opening	Baseline: C and T = 42.3 mm 1 month: C = 42.3 mm, T = 43.4 mm
Patel *et al.*[37]	10/10 (includes one drop out)	T = BTX, C = saline	TMD	Pain scale (1–10)	Baseline: C = 5.43, T = 5.4 1 month: C = 4.5 reduction, T = 1.7 reduction	N/A	N/A

Results relating to primary outcome measures

Eight out of the eleven studies used visual analogue scores (VAS) or a pain scale to assess pain.[27,28,29,31,32,34,36,37] The test groups were injected with BTX and, in most cases, the controls were injected with saline.[28,29,31,32,37] Guarda-Nardini *et al.*,[27] Carli *et al.*[34] and Chaurand *et al.*[36] being the exceptions, with the controls being subjected to a facial manipulation technique, low-level laser and conservative treatments, respectively. For the test groups (those injected with BTX) there was a reduction in scores for all of these studies from baseline to intervals up to and including three months. Guarda-Nardini *et al.*,[27] Ernberg *et al.*,[28] Lindern *et al.*,[29] Nixdorf *et al.*,[31] Guarda-Nardini *et al.*,[32] Carli *et al.*,[34] and Chaurand *et al.*[36] showed a reduction of VAS from 7.3 to 4.8 (baseline to three months on a 0–10 scale), –11% (baseline to one month), 3.2 reduction (baseline to four weeks on a 0–10 scale), 19 mm reduction (baseline to eight weeks on a 0–100 mm scale), 6.2 to 3.6 (baseline to one month on a 0–10 scale), to 3.5 (baseline to 30 days on a 0–10 scale) and 19.2% reduction (baseline to one month), respectively. Patel *et al.*[37] showed a 4.5 point reduction from 5.4 in a pain scale from baseline to one month. Aside from the study by Guarda-Nardini *et al.*,[27] these reductions in VAS were all greater than the relative control groups (Table 2). Kurtoglu *et al.*[30] used a biobehavioural questionnaire relating to RDC/TMD Axis II to assess reduction in pain, which also showed a mean reduction of scores in the test group (56.1 to 43.9 from baseline to 28 days). Again this was a larger difference than the control group (58.9 to 41.4 from baseline to 28 days).

Results relating to secondary outcome measures

There were more variable results regarding maximum mouth opening with Guarda-Nardini *et al.*[27] and Ernberg *et al.*[28] noting improvements, and Nixdorf *et al.*,[31] Guarda-Nardini *et al.*,[32] and Carli *et al.*[34] showing reductions in mouth opening from baseline to their respective intervals (Table 2).

In the study by Lee *et al.*,[33] there was a reduction in the number of EMG bruxism events per hour (using the 20% MVC criterion) in the test group from baseline to 12 weeks from 2.77 ± 1.86 to 0.26 ± 0.24; compared to the control group, which stayed relatively constant in this same time interval 2.77 ± 1.86 to 0.26 ± 0.24. The mean EMG readings by Kurtoglu *et al.*[30] of the anterior temporal muscles and masseters bilaterally at rest and maximal clenching, reduced from 206.3 mV and 296.0 mV to 165.0 mV and 199.0 mV, respectively, after 14 days in the test group; with more variable results in the control group with an increase from 200.0 mV to 252.5 mV at rest and from 529.3 mV to 498.8 mV at maximal clenching for the same time interval. Zhang *et al.*[35] noted a 48.17 kg reduction in mean maximum biting forces in the group injected with BTX after three months, relative to a 13.33 kg and 8.63 kg reduction with the group injected with saline and the one provided with no treatments, respectively.

Discussion

The results from this systematic review seem to indicate that BTX helps to lessen pain levels in those suffering from TMD. Ernberg *et al.*,[28] Lindern *et al.*,[29] Nixdorf *et al.*,[31] Guarda-Nardini *et al.*,[32] Carli *et al.*,[34] Kurtoglu *et al.*,[30] Chaurand *et al.*[36] and Patel *et al.*,[37] all demonstrated reduction in pain in the groups treated with BTX relative to the control. Despite decreases in pain with BTX, the results published by Guarda-Nardini *et al.*[27] showed that fascial manipulation provided greater improvements. A number of the trials that did not meet the inclusion criteria also demonstrated encouraging results for the effectiveness of BTX when treating patients with TMD.[38,39,40] The paper by Guarda-Nardini *et al.*[32] was the only study to look at pain as a variable in individuals with both bruxism and TMD. They showed that there was enough positive data to suggest that BTX reduced pain when chewing and at rest.

There was a general lack of trials that met the inclusion criteria when looking at the use of BTX on patients with bruxism. A plausible reason for this is that bruxism does not always result in pain and so, when looking at pain as a variable, many of the patients will fall under the umbrella of TMD. Molina *et al.* found that the prevalence of

bruxism was higher in subjects with TMD (57%) than in controls (37%).[41] The results from the papers that did meet the inclusion criteria were favourable.[32,33] Lee *et al.*[33] noted that the number of bruxism events reduced with the use of BTX and Kurtoglu *et al.*[30] showed that the EMG of the temporalis and masseter muscles both showed greater reduction during clenching, having been administered with BTX in relation to the control group, implicating force reduction by these muscle groups in the test subjects. Zhang *et al.*[35] looked at participants with both TMD and bruxism; investigating the maximal occlusal forces that can be generated as a variable. The results were clear to show that these forces were significantly lower after treatment with BTX, relative to no treatment or treatment with saline. With these studies demonstrating a reduction in the number of bruxism events and also the level of force, which for bruxists can often be significantly greater than normal functional forces, with validation from further research, BTX could certainly provide a greater level of dental protection against non-treatment in those that brux.

Other research looking at the use of BTX in the management of bruxism, that did not meet the inclusion criteria, also presented some encouraging results. Shim *et al.* showed that the use of BTX resulted in reduction in the intensity of the contractions in jaw-closing muscles[42] and trials by Sener *et al.*[43] and Bolayir *et al.*[44] both resulted in significant reduction in pain. Other studies where bruxism was the result of other conditions, such as brain injuries and autism, also exhibited promising outcomes when treated with BTX.[45,46,47,48,49,50,51]

Limitations

Despite a number of positive outcomes with the use of BTX, there were certain noteworthy limitations that were evident.

Number of participants

Many of the studies had very low number of subjects with nine of the 11 having less than 31 participants.[27,28,30,31,32,33,35,36] With such diminutive numbers of partakers, concerns relating to the reliability of the results could justifiably be raised.

Diagnostic criteria

The RDC/TMD was the most commonly used diagnostic tool for TMD.[27,28,30,31,36] However, von Lindern *et al.*[29] used their own criteria. This leads to more inconsistencies in diagnoses between studies, and ultimately makes them harder to compare. If well-recognised criteria, such as the RDC/TMD, were consistently used in future research, this would lead to a greater level of standardisation. The similar principle is applicable to bruxism, as Guarda-Nardini *et al.*[32] used their own criteria and Lee *et al.*[33] used participants who self-reported the issue.

Failed previous treatment

In some of the studies, participants were provided with BTX treatment, where previously other conservative treatments had clearly failed to address the TMD.[28,29,30] Therefore it could be argued that these groups of participants had TMDs that were more challenging to treat. By showing how BTX could be effective when other approaches were not, it would therefore be fair to hypothesise that if an average patient with TMD of myogenous origin, with no previous treatment, were to have BTX as a first line option, the results could potentially be even more favourable.

Visual analogue scores

The majority of the studies used VAS to evaluate pain.[27,28,29,31,32,34] There are mixed thoughts about the use of VAS when evaluating pain. VAS is a 'single-point measurement in time based on recall of patient to represent their pain. Patient recollection and single measurements are shown to vary considerably and so is not the most reliable or accurate method of evaluation'.[52] Others accept the limitations when using VAS to assess pain and appreciate it may be more reliable than other methods. Conti *et al.* looked at a behaviour rating scale and compared it to the reliability of VAS (a numeric scale) and determined that the best approach, with the greatest validity, to score reproducible pain was via a numeric scale.[53]

Risk of bias

The risk of bias was assessed using guidance from the Cochrane Handbook (Table 1).[54] With not a single paper showing low risk for every domain, this illustrates the necessity for further investigations where these areas of potential bias are addressed to help improve the reliability of the results. Chaurand *et al.*[36] used the same participants for the control and test, with no washout period leading to high levels of bias (Table 1).

Muscles injected

All the studies injected both masseters and temporalis muscle groups aside from three studies in which the masseters alone were injected.[28,33,35] By injecting both muscles groups there is potential for a more pronounced difference in outcomes in relation to pre-operative measurements.

Other factors to consider before treatment with BTX

Side effects

There were various side effects reported. All were temporary and some were experienced by participants in both the test and control groups (headaches, tiredness, jaw pains and influenza type symptoms).[28] Other side effects experienced by only the groups administered with BTX included minor discomfort when chewing,[27] one case of dry mouth,[28] and one patient with swallowing difficulty and temporary paralysis of facial expressions.[29,30,31,32,33] Patients also experienced temporary zygomaticus major paralysis in the study by Nixdorf *et al.*[31]

Financial costs

Unlike other treatment options for TMD and/or bruxism (for example, oral splints and exercises), administration of BTX has the benefit of not requiring daily compliance. However, BTX is an expensive treatment option. The product itself is expensive and maximum effect is usually reached at approximately two weeks, and effectiveness for approximately three to four months; at which point new nerve endings sprout from previously blocked presynaptic cholinergic nerve terminals.[55] Repeat treatments would be required at these intervals, resulting in reoccurring and, therefore, cumulative costs.

Relevant aesthetic benefits

Patients who have parafunctional habits, such as bruxism, may also develop hypertrophy of the masseters. This may have aesthetic implications in the form of squaring of the jaw (wide lower third of the face with prominent mandibular angles). This is thought to be an unfeminine characteristic, unlike triangular and heart-shaped faces. The use of BTX helps reduce this effect and can therefore lead to what some may deem as an improved facial aesthetic outcome.[56]

Conclusion

Although the evidence to support the use of BTX in the treatment of TMD of myogenous origin and bruxism is not entirely unequivocal, there is certainly enough evidence to justify further research into these areas. There are a sufficient number of studies, despite their limitations, showing promising results and degrees of effectiveness. It will be unlikely that participants who have not had previous treatment or no

previous treatment failures could be recruited for such studies, but larger study sizes would be more reasonable. Financial viability is an issue with BTX, however unlike the use of oral splints to manage TMD and bruxism, BTX does not pose as much of a compliance issue and can provide potential aesthetic benefit. Considering highly targeted treatment for unilateral/localised myofascial pain/spasms with BTX is likely to be less of a financial burden but again, is likely to incur difficulties in formulating studies with large number of participants.

The multifaceted nature of TMD and bruxism and their actual aetiology cannot be emphasised enough. TMD 'arise[s] from multiple sources and involve[s] complex interactions between psychosocial and biological variables'.[57] The WHO recognises teeth grinding (bruxism) in its ICD-10 and describes it as a 'somatoform disorder' under the mental and behavioural disorders sub-classification.[5] It is, therefore, important to establish that BTX does not have a role in tackling the underlying aetiology of TMD or bruxism but only in the potential outcomes (for example, pain and bruxism events). Primary conservative options, such as self-management with explanation, should clearly be exhausted first before BTX is considered.

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