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Tanta Dental Journal 12 (2015) 156–162
www.elsevier.com/locate/tdj

Evaluation of using botulinum toxin (A) in the treatment of myofacial pain syndrome

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Received 22 January 2015; revised 9 March 2015; accepted 28 March 2015
Available online 8 August 2015

Abstract

Myofacial pain syndrome (MPS) is a disorder which has become a topic over the past two decades and nowadays .10 patients (9 female & 1 male) complaining of unilateral MPS were injected with botulinum toxin type A(BTX-A) in masseter and temporalis muscles extra orally under electromyographic guidance (EMG) since they are the primary muscles responsible for pain in ear region and temporal headache respectively, which cause limitation of mandibular movement and development of MPS. EMG evaluation of the results together with clinical one were taken at baseline before injection, after 1, 2, 3 and 6 months following the last injection. The study revealed that BTX-A reduced the severity of symptoms and improve functional abilities for patients with MPS and these extend beyond its muscle - relaxing effects.

Keywords: Botulinum toxin (A); Myofacial pain dysfunction syndrome

1. Introduction

MPS is a disorder which has become a topic of increasing interest over the past two decades, this might be attributed to the fact that this disorder was reported to affect at least 20% of all patients seen by the dental practitioners [1,2].

MPS refers to a collection of symptoms associated with functional and structural disturbances of temporomandibular joint (TMJ) and masticatory muscles. These symptoms more commonly include pain, tenderness of TMJ and muscles of mastication, TMJ sounds during condylar movements and limitation of mandibular movements [3]. The great interest directed toward MPS recently is due to, although it begins as a functional muscular disorder, it ultimately can lead to degenerative arthritis in TMJ [4–6].

The treatment of patients with MPS includes both conservative which has gained a wide acceptance and surgical procedures. It was generally accepted that the predominant attitude toward treatment should be

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Peer review under the responsibility of the Faculty of Dentistry, Tanta University.

http://dx.doi.org/10.1016/j.tdj.2015.03.001
1687-8574/

conservative one, only those patients with demonstrable articular pathological conditions who have not responded to usual conservative therapy are subjected to surgery [7,8].

In the recent years, BTX-A[1] has been successfully used for treatment of different types of chronic pain including, cervicogenic migraine, tension type and chronic daily headaches and chronic pain related muscular disorders [9–11]. Directing treatment to the muscular component of MPS could yield important therapeutic gains by new therapeutic agent which possess high specificity as well as tolerable side effects. Accordingly, this study was planned to investigate the effect of BTX-A as a minimally invasive method for treatment of MPS.

2. Material and methods

10 patients (9 female & 1 male) randomly selected from Out-Patient Clinic of the Oral and Maxillo Facial Surgery Department, Faculty of Dentistry, Tanta University, their ages ranged from 19 to 50 years with a mean of 32 years. They were assessed according to criteria of Helkimo clinical dysfunction index (Di) [12–15], clinical finding and surface electromyography was used instead of needle electrodes which regarded as invasive procedures in which needle electrode is inserted through the skin into the muscles. Either technique can be performed safely with accuracy confer the best results, but passive surface EMG considered less invasive and less painful. The patients were selected to fulfill the criteria of MPS proposed by previous investigators, five of them were suffering from painful clicking.

2.1. Electromyographic analysis

Surface electromyographic[2] recording of masseter and temporalis muscles were taken using 2-channel EMG3 apparatus with input impedance 100 M Ω and band width 2 Hz–1 kHz gain 100–200 MV. Simultaneous recording of myoelectrical activity for both the affected and the healthy side which was considered the control side [16].

For masseter muscle, the active recording electrode was placed over a motor point of the muscle and the reference electrode was placed over the angle of the jaw.

For temporalis muscle, the active recording electrode over motor point on the muscle and the reference electrode were placed over a non-hair bearing area of temporalis muscle. The amplitude of EMG signal measured during maximal biting position (static test).

Surface EMG recording were taken from masseter and temporalis muscles indicate hyperactivity of muscles. EMG was taken at baseline before injection, after 1, 2, 3 and 6 months following the last injection EMG-Guided BTX-A injections in the hyperactive masseter and temporalis muscles were performed via an extra oral approach without anesthesia [17–20].

The injection was generally carried out at the same visit. BTX-A was injected into the masseter and temporalis muscles. One hundred units were reconstituted with 2.5 ml of sterile saline. Five injections were done for each patient, two injections (2 × 4 U) were given 1 cm superior to the inferior border of the mandible, two other injections of units (2 × 4 U) were given1 cm inferior to the inferior border of the zygomatic arch and a fifth injection (1 × 4 U) was given in the center of the masseter muscle [20,21] (Fig. 2). Injection of temporalis muscle was best done just above the level of the zygomatic arch at the junction of the scalp and non-hair bearing temporal skin [22,23]. Three points of injections of 4 units (3 × 4 U) were given 1 cm inferior to the origin of the temporalis muscle (Fig. 3).

Aspiration before injection was done, then slow intramuscular injection was done with bevel of the needle toward skin, inserting whole needle in the muscle with 45° angulation with skin which assure least trauma and pain. Follow up scores obtained by the questionnaire, clinical examination according to Di and EMG analysis, MIO at 1, 2, 3 and 6 months intervals after injection (Figs. 4 and 5).

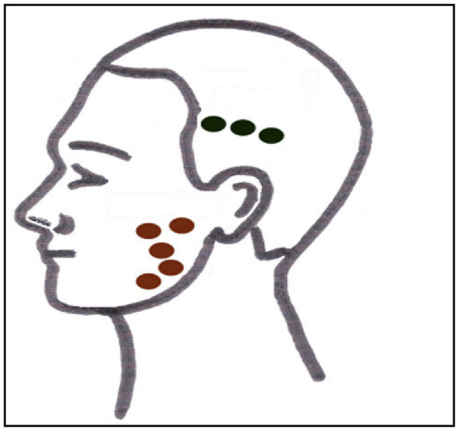

Fig. 1. Diagramatic illustration for injection points of masseter&temporalis muscles.

[1] BTX-A: Botulinum toxin type A (Allergan, Inc., Iruine, CA, USA).

[2] Neuropak II (Nihon koden. Japan).

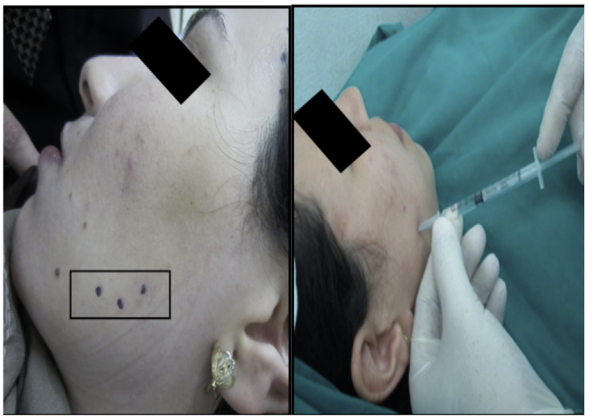

Fig. 2. Points of injection of masseter muscle.

Helkimo clinical dysfunction index (Di)

- Range of mandibular motion;
  Normal rang of movement. 0
  Slightly impaired mobility. 1
  Severely impaired mobility. 5
- TMJ function impairment;
  Smooth movement without sound and deviation on opening and closing 0
  TMJ sound in one or both joints and/or deviation $\geq$ 2 mm on opening or closing movement. 1
  Locking and/or luxation of TMJ. 5
- Muscle tenderness during palpation;
  No tenderness to palpation. 0
  Tenderness to palpation in 1–3 palpation sites. 1
  Tenderness to palpation in 4 or more sites. 5
- TMJ pain during palpation;
  No tenderness to palpation. 0
  Tenderness to palpation laterally. 1
  Tenderness to palpation posteriorly. 5

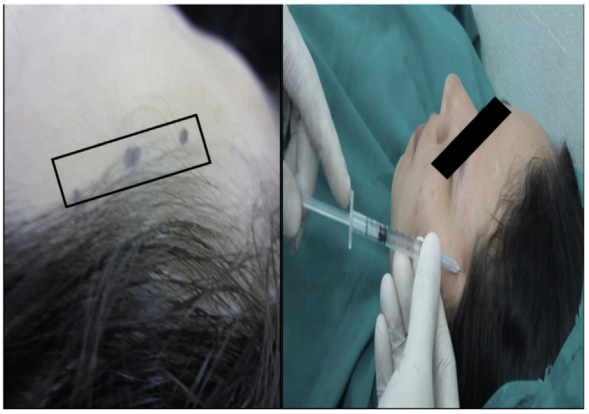

Fig. 3. Points of injection of temporalis muscle.

- Pain during mandibular movement;
  No pain on movement. 0
  Pain on 1 movement. 1
  Pain on 2 or more movement. 5

The individuals were classified in four groups:

Di-0: 0 points – Individuals clinically free from dysfunction symptoms;
Di-I: 1 to 4 points – Individuals with mild dysfunction symptoms;
Di-II: 5 to 9 points – Individuals with moderate dysfunction symptoms;
Di-III: 10 to 25 points – Individuals with severe dysfunction symptoms

3. Results

3.1. Clinical results: (Tables 1–3) & (Figs. 1 and 2)

Preoperatively, MIO ranged from 19 to 28 mm. After 6 months (end of observation period), it was ranged from 35 to 45 mm. There were statistically significant differences in MIO between preoperative value and at the end of observation period of the study, where P-value was 0.001.

There was statistically non-significant difference in clicking between preoperative and post-operative value at the different observation periods of the study where P-value was 0.067.

The Di score preoperatively was III which indicate severe dysfunction for all patients (100%). At the end of the observation period there were half patients 50% with Di:0 and rest (50%) with Di:I. There were statistically significant difference in Di score between preoperative and postoperative values at the different observation periods were P-value was 0.031.

3.2. Electromyographic results

The preoperative surface EMG recording of masseter muscle of the healthy side which considered control group ranged from 0.20 to 0.77 mv, while at the affected side it ranged from 0.38 to 1.17 mv. The difference between healthy and affected side of masseter muscle was statistically significant.

At the end of the period of the study, surface EMG recording of the healthy side of masseter muscle was ranged from 0.20 to 0.77 mv and at the affected side was ranged from 0.30 to 0.75 mv. There were no statistically significant differences in surface EMG recording between healthy and affected side at the end of observation period.

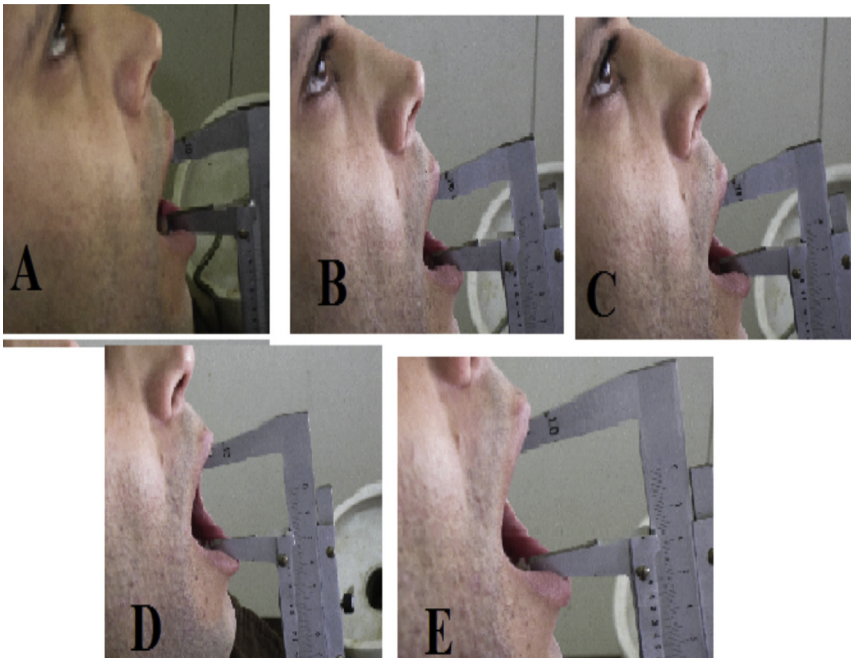

Fig. 4. Photographs of patient no (4) Showing maximal mouth opening after injection & different periods of study, A before injection, B after one month, C after two months, D after three months and E after six months.

The preoperative surface EMG recording of temporalis muscle of the healthy side which considered control group ranged from 0.23 to 0.60 mv, while at the affected side it ranged from 0.40 mv to 1.10. The difference between healthy and affected side of temporalis muscle preoperatively was statistically significant. At the end of the period of the study surface EMG recording of healthy side of temporalis muscle ranged from 0.23 to 0.60 mv and at the affected side was ranged from 0.32 to 0.70 mv of. There were statistically significant differences between healthy and affected side of the muscle at end of observation period.

4. Discussion

BTX-A is a useful new therapeutic agent which has been used successfully for treatment of many painful clinical disorders by direct injection in the painful area [4,24]. Therefore the aim of this study was to evaluate the clinical outcomes and the effects of intramuscular

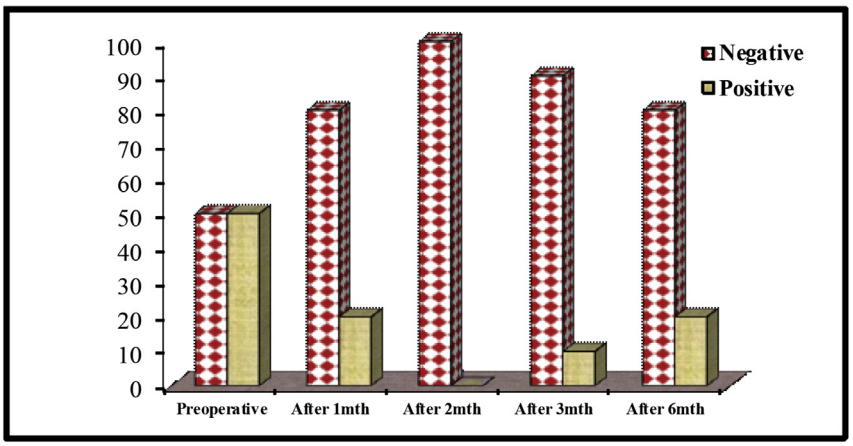

Fig. 5. Bargraph showing decrease in clicking preoperative, after injection and during the different observation periods of the study.

Table 1
Statistical analysis of Helkimo clinical dysfunction index of the affected side at different observation periods of the study.

(Di)		0		I		II		III	
		N	%	N	%	N	%	N	%
Preoperative		0	0.00	0	0.00	0	0.00	10	100.00
After 1 mth		0	0.00	7	70.00	3	30.00	0	0.00
After 2 mths		1	10.00	9	90.00	0	0.00	0	0.00
After 3 mths		3	30.00	6	60.00	1	10.00	0	0.00
After 6 mths		5	50.00	5	50.00	0	0.00	0	0.00
Chi-square	X^2	13.852							
	P-value	0.031[a]							

[a] Statistically significant difference at 5% level.

Table 2
Statistical analysis of electromyographic measurements of masseter muscle of the affected side at different observation periods of study.

	Masseter muscle		Difference		Paired t-test	
	Range	Mean ± SD	Mean	SD	t	P-value
Preoperatively	0.38–1.17	0.77 ± 0.25				
After 1 mth	0.30–0.93	0.56 ± 0.20	0.21	0.11	6.02	<0.001[a]
After 2 mths	0.20–0.70	0.44 ± 0.16	0.34	0.20	5.42	<0.001[a]
After 3 mths	0.27–0.73	0.46 ± 0.15	0.32	0.18	5.40	<0.001[a]
After 6 mths	0.30–0.75	0.52 ± 0.16	0.25	0.15	5.30	<0.001[a]

[a] Statistically significant difference at 5% level.

Table 3
Statistical analysis of electromyographic measurements of temporalis muscle of the affected side at different observation period of the study.

	Temporalis muscle		Difference		Paired t-test	
	Range	Mean ± SD	Mean	SD	t	P-value
Preoperatively	0.40–1.10	0.70 ± 0.19				
After 1 mth	0.33–0.73	0.48 ± 0.12	0.22	0.13	5.29	<0.001[a]
After 2 mths	0.27–0.50	0.36 ± 0.08	0.34	0.20	5.46	<0.001[a]
After 3 mths	0.30–0.60	0.43 ± 0.11	0.27	0.15	5.67	<0.001[a]
After 6 mths	0.32–0.70	0.52 ± 0.12	0.18	0.11	4.94	<0.001[a]

[a] Statistically significant difference at 5% level.

injection of BTX-A into masseter and temporalis muscles extra orally for management of MPS.

Helkimo clinical dysfunction index was used to diagnose and evaluate the efficacy of treatment of MPS with BTX-A in this study by recording the progress of its five criteria which was adopted and appreciated by Khedr, Suzana et al., who used Di for diagnosis and assessment of TMD patients during evaluation period of their studies [12–15].

In this study surface EMG was used for measurement of muscular activity, which considered an important component of diagnosis and biofeedback treatment of MPS [25–29]. Temporalis and masseter muscles were evaluated at maximal voluntary contraction, where clinical observations and electromyographical findings complemented each other. This was in agreement with Yang, Zhang [30], who reported that EMG is a valuable research tool in diagnosis of TMD and in evaluating the effectiveness of treatment. Accordingly, we use this technique in this study for assessment of muscle activity, where all injections of BTX-A were intramuscular as verified by surface EMG guidance, extra orally without any anesthetic agent using insulin syringe. The procedure was painless, assessment were carried out after 1, 2, 3and 6 months [31,32].

9 patients were females and only one was male. This female predilection can be explained on the believe that females are more related to increased psychological stress as well as excessive muscle function. This was in agreement with the psychological theory of Gordon et al. [33], who reported that MPS is common in female in second to fifth decades of life because of different perception and response to symptoms compared to men.

The analysis of clinical and myographical results showed an improvement in the mean value of MIO from 22.6 mm before injection to 38.5 mm at the end of the study period. This was accompanied with an improvement in the range of mandibular motion. These might be attributed to the increased muscular relaxation, reduction of inflammation and disappearance of pain which was essentially described by Freund et al., [4,20].

In this study there were only 5 patients suffering from clicking which disappeared after one month for three patients, and after two months for the other two patients, but recurrence had occurred to these two patients associated with pain in the temporal region at the end of study period. This agree with Schwartz et al., [4], who reported that although clicking was significantly reduced midway through his study, it had returned to pretreatment value by the final two assessments. The two patients with recurrent clicking had received a second injection in temporalis muscle only after three months due to recurrence of pain attacks in temporalis muscle only. This agrees with Cheshire et al. [18], who described that most individuals in his study have had only two series of injections at most.

Another observation in this study was that all patients had improved functional index score, marked reduction in pain and muscle tenderness as revealed by Di, from Di: III before injection to Di: 0 and Di: I at the end of observation period, which was adopted by Khedr, Suzana [12–15].

According to Malcolm et al. [3], EMG measurement appeared to be more useful and reliable method in determining the prognosis of treatment. This was in agreement with the present study, where the average level of muscle activity of temporalis muscle during maximal biting decreased. There was statistically significant difference between healthy and affected side of the muscle at end of observation period coinciding with improvement of the signs and symptoms of MPS. Unlike masseter muscle, where there was no statistically significant difference in surface EMG recording between healthy and affected side at the end of observation period, which might attributed to improper dose in relation to size of muscle. This was in agree with Freund, Schwartz [4,8,20], who reported that further improvement was noticed after carrying out the treatment one more time.

The results of this study revealed a gradual and well established decrease in muscular activity which was statistically significant during the study period for both masseter and temporalis muscles. This agree with Karacalar et al. [34], who reported reduction in MVC in all main out comes measures between pretreatment assessment and the different follow up assessment. Similarly Isberg et al., [35] in their studies found that the improvement coincided with objective and subjective weakening of masseter and temporalis muscles.

There were no side effects either at the injection visit or during observation period neither local nor systemic. Unlike Clark, Issac [36,37], who reported an itching at the injection site, headache, dry mouth and flu-like symptoms as systemic side effects. They explained these side effects due to improper muscle targeting of BTX-A, which lead to escape of the solution in to neighboring anatomical structures producing undesirable effects [38].

5. Summary and conclusion

In the last decades dramatic advances have been made in understanding the causes of facial pain related to TMD. Because of the multifactorial nature of the disease, the treatment methodology varies greatly among clinicians but had the same aim of control of pain and discomfort. BTX.A is safe, well tolerated and can be used for management MPS. There were no side effects, neither local nor systemic from BTX-A injection. Due to great controversy about BTX-A, further researches is necessary on the exact mechanism of BTX-A for chronic pain management and its role in multifactorial treatment. Future researches should include expanding the domain of treatable diseases, comparing injection intervals, formation of antibodies, cost and complications.

References

[1] Bell WE. Clinical diagnosis of the pain dysfunction syndrome. J Am Dent Assoc 1969:79–154.
[2] El Beialy RR. TMJ order & disorder text book. 1st ed. The Egyptian Printing Centre Cairo; 1988.
[3] Laskin DM. Etiology of the pain dysfunction syndrome. J Am Dent Assoc 1969:79–147.
[4] Schwartz M, Freund B, Symington JM. Botulinum toxin: new treatment for temporomandibular disorders. Br J Oral Maxillofac Surg 2000;38:466–71.
[5] Copeland ME, Starlanyl DJ. Fibromyalgia & chronic myofascial pain. New Harbinger Publication; 2001. p. 230–2.
[6] Clark RP, Berris CE. Botulinum toxin: a treatment for facial asymmetry caused by facial nerve paralysis. Plast Reconstr Surg 2005:573–4.
[7] Bradly PF. Conservative treatment for tempromandibular joint pain dysfunction. Br J Oral Maxillofac Surg 1987:125–37.
[8] Freund BJ, Schwartz M. The use of botulinum toxin for the treatment of temporomandibular disorder. Oral Health 1998;88:32–7.
[9] Schult-Mattler WJ, Weleser T, Zierz S. Treatment of tension type headache by botulinum toxin: a pilot study. Eur J Med Res 1999;4:183–6.
[10] Silbersation S, Mahew N, Saper J. Botilinum toxin type A as a main preventive treatment. Headache 2000;40:445–50.
[11] Okeson JP. Management of temporomandibular disorders and occlusion. 4th ed. St. Louis Nosby Comp; 1998. p. 144–70.
[12] Khder MS. The effect of using laser in the treatment of myofacial pain dysfunction syndrome. Egypt Dent J 1998;44(3478):3494. Oct. ed. St louis, Mosby Company. 1998.
[13] Helkimo M. Studies of function & dysfunction of the masticatory system. Suedish Dent J 1974;67:1–21.
[14] Fricton JR, Schiffman EL. Reliability of craniomandibular index. J Dent Res 1986;65:1359–64.
[15] Da Cunba Suzana C, Ricardo VB, Angla PD. Analysis of helkimo and craniomandibular indexes for TMJ disorders. Rev Bras Otorinolaringol 2007;73:19–26.
[16] Widmer CG. Temporomandibular joint sounds: a critique of techniques for recording and analysis. J Craniomandib Disord 1989;4:213–7.
[17] Woo Seog S. Application of botulinum toxin in pain management. Korean J Pain 2011;24:1–6.
[18] Cheshire WP, Abashian SW, Mann JD. Botulinum toxin in the treatment of myofacial pain syndrome. Pain 1994;59:65–9.
[19] Lim EC, Seet RCS. Review description of injection technique. Acta Neurol Scand 2008;117:73–84.
[20] Freund BJ, Schwartz M. Intramuscular injection of botulinum toxin as an adjunct to arthrocentesis of the temporomandibular joint: preliminary observations. Br J Oral Maxillofac Surg 2003;41:351–2.
[21] Babadag M, Sahin M, Gorgum S. Pre- and post treatment analysis of clinical symptoms of patients with tempromandibular disorders. Quintessence Int 2004;35:811–4.
[22] Syrop SB. Initial management of temporomandibular disorders. Dent Today 2002;21:52–7.
[23] Kim HJ, Yun KW, Lee SS, Heo MS, Seo AK. Effects of botulinum toxin type A on bilateral masseteric hypertrophy

evaluated with computed tomographic measurement. Dermatol Surg 2005;29:484−9.
[24] Vani SJ, Keith DA, Kaban LB. Temporomandibular disorders. N Engl J Med 2008;359:2693−705.
[25] De Laat A, Stappaers K, Papy S. Counseling and physical therapy as treatment for myofascial pain of the masticatory system. J Orofac Pain 2003;17:42−9.
[26] Okeson JP. Management of temporomandibular disorders and occlusion. 6th ed. St. Louis, (Mo): The CV Mosby Company; 2008.
[27] Klasser G, Greene C. Oral appliances in the management of temporomandibular disorders. Oral Surg Oral Med Oral Med Oral Pathol Oral Radiol Endod 2009;107:212−23.
[28] Carvajal W, Laskin DM. Long-term evaluation of MPDS. J Oral Maxillofac Surg 2000;58:852−5.
[29] Venancio-Rde A, Alencar FG. Different substances and dry-needling injection in patients with myofacial pain and headaches. Cranio 2008;26:96−103.
[30] Yang CSY, Zhang X. DMR:EMG applied to the diagnosis of MPDS and TMJ disorders. Int J Oral Maxillofac Surg 2005;34:733−9.
[31] Botulinum toxin type A in the management of oromandibular dystonia and bruxism. In: Tintner R, Jankovic J, Brin MF, Hallet M, Jankovic J, editors. Scientific and therapeutic aspects of botulinum toxin. Philadelphia: Lippincott, Williams and Wilkins; 2002. p. 343−56.
[32] Ferrario VF, Treataglia GM, Galletta A, Grassi GP, Sforza C. The influence of occlusion on jaw and neck muscle activity: a surface EMG study in healthy young adults. J Oral Rehabil 2006;33:341−8.
[33] Gordon D, Finkelstein Ian, Freund Brain, Dhawan Pankaj. Botulinum toxin type A in pain management. Pract Pain Manag Oct 2008.
[34] Karacalar A, Yilmaz N, Bilgici A, Bas B, Akan H. Botulinum toxin for the treatment of temporomandibular joint disk disfigurement: clinical experience. J Craniofac Surg 2005;16:476−80.
[35] Isberg A, Widmalam SE, Ivarsson R. Clinical, radiographic, and electomyographic study of patient with internal derangement of the temporomadnibular joint. Am J Orthod 1985;88:453−60.
[36] Clark GT. The use of botulinum toxin for the treatment of temporomandibular disorders: preliminary findings. J Oral Maxillofac Surg 1999;57:920−1.
[37] Isaac AM. Unilateral temporalis muscle hypertrophy managed with botulinum toxin type A. Br J Oral Maxillofac Surg 2000;38:571−2.
[38] Mantel AM. Dilution strange and electromyographic guidance in use of botulinum toxins. Dermatolclin 2004;22:135−46.