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EVALUATION OF BOTULINUM NEUROTOXIN-A IN THE TREATMENT OF MASSETER MUSCLE HYPERTROPHY AMONG A SAMPLE OF IRAQI PATIENTS

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Abstract:

Background: Masseteric muscle hypertrophy is considered a benign disease that is characterized by the enlargement of the masseter muscles. Botulinum neurotoxin-A is considered one of the most poisonous biological materials known,

Aim: To evaluate the efficacy and safety of botulinum neurotoxin-A in the treatment of masseter muscle hypertrophy.

Patients and method: A clinical therapeutic trial was conducted at the Department of Desintry/ Al-Hadi University College during the period from the 1st of January 2022 to the first of April 2023. A total of 20 patients who were presented with masseter muscle hypertrophy were enrolled in the current study. After confirming the muscle with an ultrasound examination, botulinum neurotoxin-A was injected

Results: There were significant differences between the muscle diameter in relaxation and contraction conditions at 2, 4, and 12 weeks after treatment compared to the muscle diameter before treatment (P-values were 0.001 for all). There were no significant differences between the maximal bite force at 2, 4, and 12 weeks after treatment compared to the maximal bite force before treatment (P-values were 0.308, 0.198, and 0.155, respectively). Significant differences were obtained between the tragus-angle line at 2, 4, and 12 weeks after treatment compared to the tragus-angle line force before treatment (P-values were 0.001 for all).

Conclusion: The botulinum neurotoxin-A can be used effectively and safely in the treatment of masseter muscle hypertrophy, it was associated with a significant decrease in the diameter of the masseter muscle and tragus-angle line.

Keywords: Botulinum neurotoxin-A, masseter muscle, hypertrophy

INTRODUCTION

Masseter muscle is one of the masticatory muscles[(1)], It has two divisions, comprising the superficial and deep divisions[(2)].

The superficial part originates from a thick aponeurosis on the inferior side of the zygomatic arch and the temporal process of the zygomatic bone. The fibres run inferior-posteriorly in this division and insert onto the mandibular angle at the masseteric tubercle and the inferior section of the lateral side of the mandibular ramus[(3)].

The deep section begins throughout the full length of the zygomatic arch, proceeds inferiorly, and connects to insert on the mandibular ramus, superior and deep to the superficial portion. The superficial portion roofs the deep section anteriorly, whereas the parotid gland protects it posteriorly. The masseteric branch of the anterior trunk of the mandibular nerve innervates both layers[(4)].

The masseter muscle's main job is to lift the mandible off the maxilla and produce an occlusal force which is frequently measured to assess oral function[(5)]. In addition, the mandible's extension and lateral movements are also partially mediated by the masseter muscle. Additionally, the masseter muscle is very important for maintaining facial beauty. [(4, 6)].

Masseteric hypertrophy is categorized as a benign disorder characterized by the enlargement of the masseter muscles[(7)]. Without regard to gender, the highest incidence of masseter muscle hypertrophy is in the second and third decades of life[(8)].

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The main causes of masseter muscle hypertrophy are biting force, type of food, diet chewing habits, or habits such as bruxism, teeth clenching, or any other temporomandibular joint disorder[9].

Usually, masseter hypertrophy cases are bilateral and symmetric, but asymmetry is not uncommon. [8]. Masseter muscle hypertrophy is linked to a square-angled lower face, discomfort, dental attrition, maxillary and mandibular bone resorption, and accelerated ageing of the lower face[10].

Botulinum elaborates on eight antigenically distinguishable exotoxins (A, B, C1, C2, D, E, F and G). Botulinum neurotoxin-A is considered one of the common poisonous biological elements[11]. Botulinum neurotoxin-A is derived from Clostridium botulinum and inhibits acetylcholine release at neuromuscular connections, resulting in reduced muscle contraction, peripheral sensitization mitigation, and, secondarily, central sensitization suppression[12, 13].

Botulinum neurotoxin-A intramuscular injections are used to treat focal spasticity and dystonia, hyperhidrosis, overactive bladder, and aesthetic operations. Intradermal or subcutaneous injections are used to alleviate neuropathic pain[14, 15].

AIM OF THE STUDY: To evaluate the efficacy and safety of botulinum neurotoxin-A in the treatment of masseter muscle hypertrophy.

PATIENTS AND METHODS:

A clinical therapeutic trial was conducted at the Department of Desintry/ Al-Hadi University College during the period from the 1st of January 2022 to the first of April 2023.

A total of 20 patients who were presented with masseter muscle hypertrophy were enrolled in the current study.

Patients having temporomandibular joint diseases other than masseter muscle hypertrophy including degenerative joint disease, jaw deformity, and neurological or mental illnesses in addition to patients who had prior botulinum neurotoxin-A injections were excluded from the research.

Age, sex, and clinical information, such as masseter muscle thickness, maximum biting force, and tragus-angle line before treatment and 2, 4, and 12 months following treatment, were gathered using a standardised questionnaire. Additionally, the treatment side effects including restricted smiles, masticatory tiredness, and asymmetric smiles were recorded.

The tongue and teeth of each patient were checked for erosions. The maximum biting force as well as the length of the line from the tragus to the angle of the mouth were measured.

Before the injection, the patients had an ultrasound examination to check the position, thickness of the masseter muscles, and the presence of any anatomical abnormalities (Figure 1).

Figure 1: Ultrasound examination

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After confirming the muscle with an ultrasound examination, botulinum neurotoxin-A was injected. The solution was prepared by diluting 100 units of botulinum neurotoxin-A with 2.5 mL of normal saline according to industry standards.

A topical anaesthetic drug was administered before the beginning of the procedures. The patient was then instructed to clench and hold his teeth to indicate the masseter's anterior boundary and largest protrusion. The injection site was limited to 1.5–2 cm away from the lower border of the jaw to prevent harm to the marginal mandibular nerve by drawing a line from the tragus to the corner of the mouth to indicate the superior boundary and marking the inferior boundary. Anterosuperior, posteroinferior, anteroinferior, mid-inferior, and mid-superior were the six equally spaced spots that were indicated for injection.

Two units were injected into each spot using a 100-unit syringe perpendicularly into the largest portion of the muscle.

To control bleeding after surgery, an ice pack is applied. An ultrasound was conducted after the injection to monitor for problems such as hematoma.

The Al-Hadi University College authorised the study procedure. Before the patient's enrolment, written informed consent was sought from them. The Declaration of Helsinki's guidelines were followed in conducting the study.

RESULTS

A total of 20 patients were enrolled in the current study, 5 (25%) of them had an age of < 30 years. More than half of them (60%) were male (Table 1).

Table 2: Age and gender distribution of the patients

Age and gender		N (%)
Age group	<30	5 (25.0)
	30-39	8 (40.0)
	40-60	7 (35.0)
Gender	Male	12 (60.0)
	Female	8 (40.0)

There was a significant difference between the muscle diameter at relaxation and contraction 2 weeks, 4 weeks, and 12 weeks after treatment compared to the muscle diameter before treatment (P-values were 0.001 for all), as shown in table 2 and figure 1.

Table 2: Chane of the muscle diameter after treatment

Muscle diameter (mm)	Before treatment	2 weeks after treatment	4 weeks after treatment	12 weeks after treatment
At relaxation	11.2 (1.0)	8.3 (0.4)	7.2 (0.4)	6.9 (0.8)
P-value		0.001	0.001	0.001
At contraction	13.7 (0.5)	12.2 (0.5)	9.4 (0.1)	9.07 (0.2)
P-value		0.001	0.001	0.001

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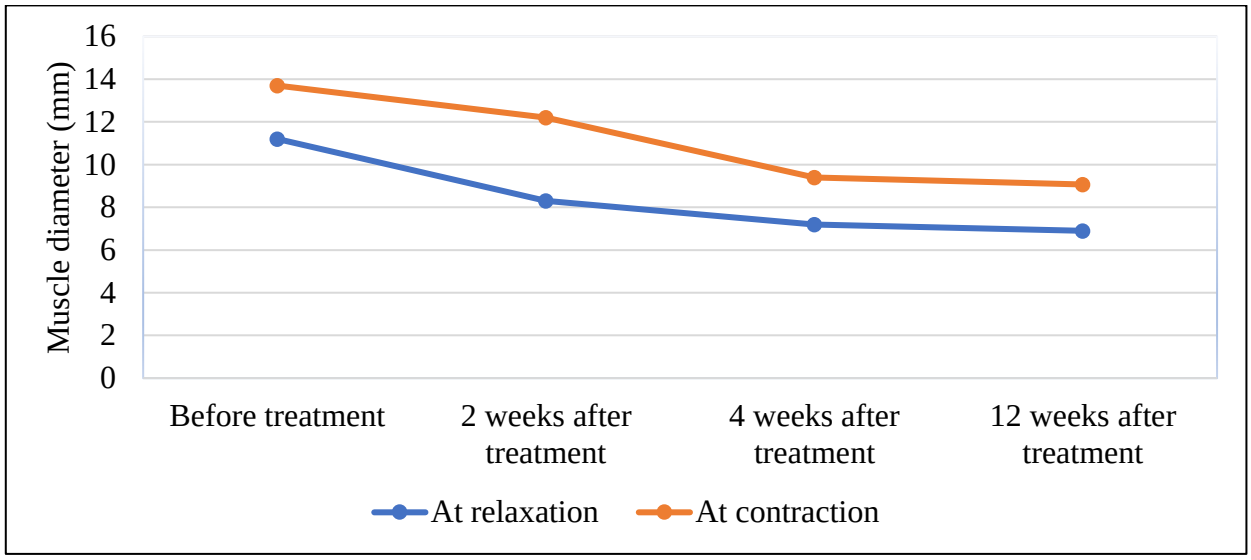

Figure 1: Trend of the muscle diameter after treatment

There were no significant differences between the maximal bite force 2, 4, and 12 weeks after treatment compared to the maximal bite force before treatment (P-values were 0.308, 0.198, and 0.155, respectively). As shown in table 3.

Table 3: Change of the maximal bite force after treatment

	Before treatment	2 weeks after treatment	4 weeks after treatment	12 weeks after treatment
Maximal bite force ((Kg/m^2)	30.9 (0.9)	30.5 (1.3)	30.6 (1.2)	30.5 (1.3)
P-value		0.308	0.198	0.155

Significant differences were obtained between the tragus-angle line at 2, 4, and 12 weeks after treatment compared to the tragus-angle line force before treatment (P-values were 0.001 for all), as shown in table 4.

Table 3: Change of the tragus-angle line after treatment

	Before treatment	2 weeks after treatment	4 weeks after treatment	12 weeks after treatment
Tragus-angle line (mm)	11.2 (1.0)	8.3 (0.4)	7.2 (0.4)	6.9 (0.8)
P-value		0.001	0.001	0.001

Regarding the complications, 1 (5%) of the patients had smile limitation while non of them had masticatory fatigue or smile asymmetry (Table 4).

Table 4: Complications of treatment

Complications	N (%)
Smile limitations	1 (5.0)
Masticatory fatigue	0 (0.0)
Smile asymmetry	0 (0.0)

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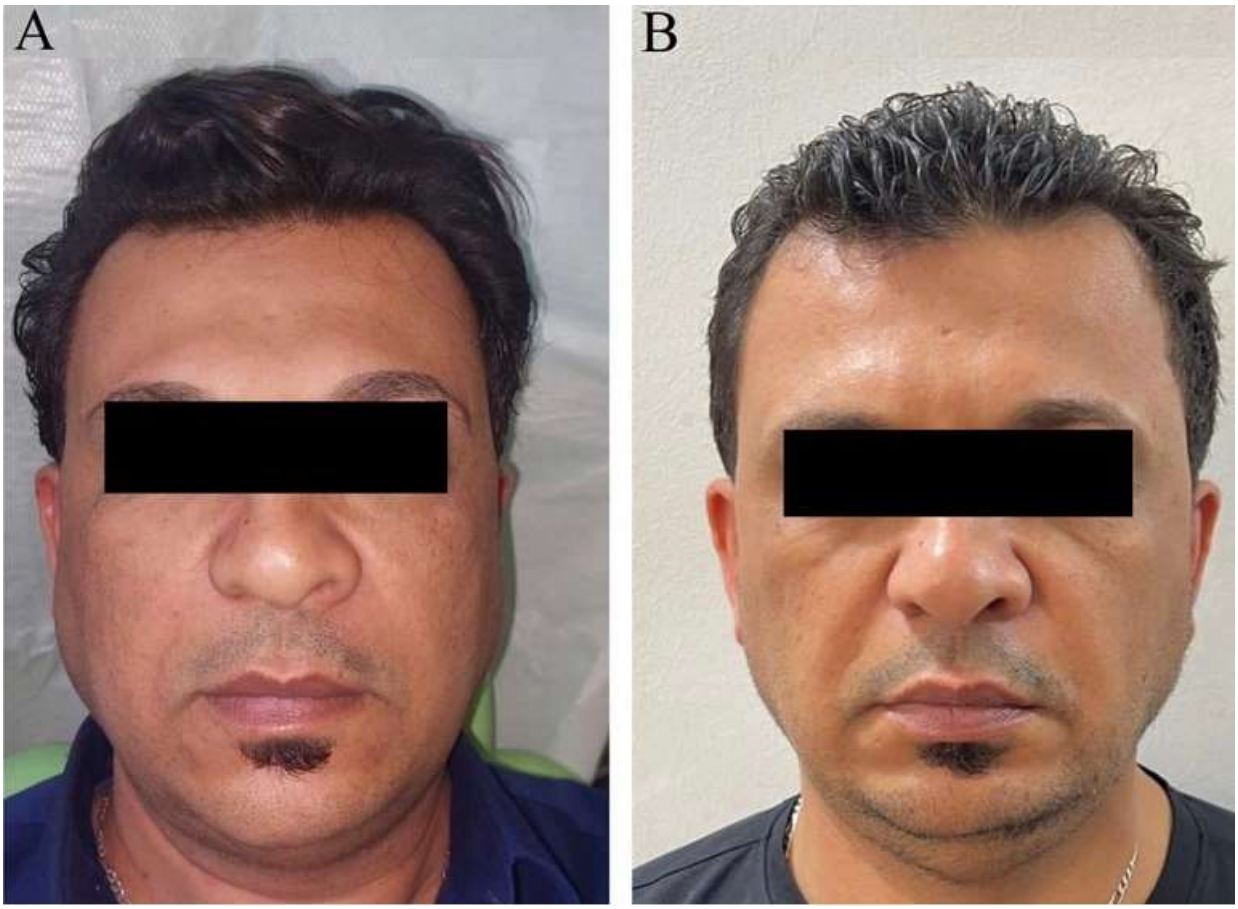

Figure 2: Patient with masseter muscle hypertrophy. A: Before treatment. B: After treatment

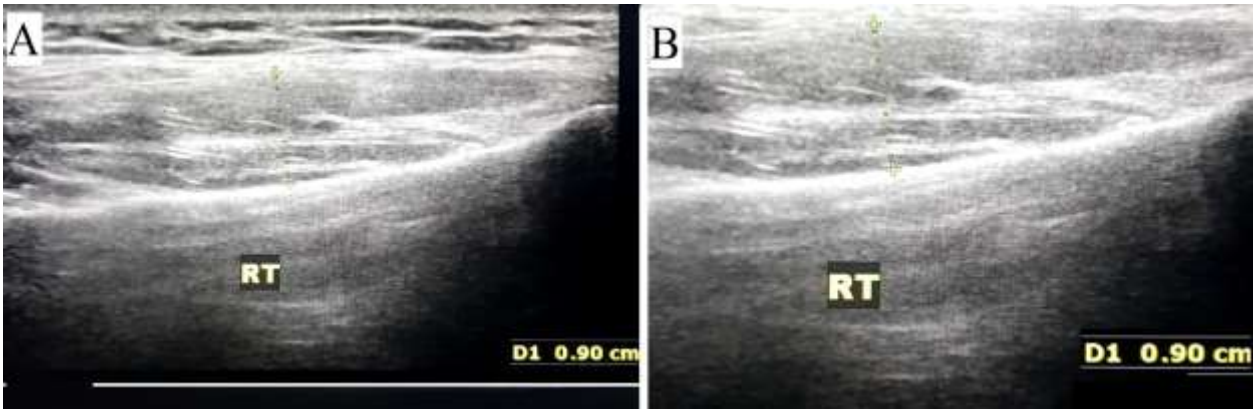

Figure 3: Ultrasound examination of the masseter muscle. A: Before treatment. B: After treatment

DISCUSSION

It used to be a common practice to perform a muscular surgical reduction to treat masseter muscle hypertrophy, but this procedure carries a significant risk of damaging the facial nerve in addition to other complications of general anaesthesia, postoperative haemorrhage, oedema, hematoma, infection, and scarring. So, to treat masseter muscle hypertrophy, medical therapy with botulinum neurotoxin-A began to be employed[16]. This study was one of many that looked at the effectiveness and safety of using botulinum neurotoxin-A to treat masseter muscle hypertrophy.

Patients aged 30-39 years old constituted the largest proportion of the sample. Males constituted the largest proportion of the sample. The male to female ratio in another study that was done in Turkey was 3/17, while the mean age was 29.6 years[17].

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The main finding of the current study was that the diameter of the masseter muscle significantly decreased after treatment at 2 weeks, 4 weeks, and 12 weeks. In comparison, the same results were obtained in another study that was done in Brazil by Fernanda et al. who concluded that the use of botulinum neurotoxin-A is effective for masseter muscle hypertrophy[18]. This agreed with the results of another study that was done in Korea by Nam-Ho et al. which concluded that masseter muscle hypertrophy was affected by botulinum neurotoxin-A injections for a long time[19]. In agreement, Kasturi concluded that postulated that botulinum neurotoxin-A can be used effectively in the treatment of masseter muscle hypertrophy[20]. The same results were obtained in another study that was done by Hwa-Jin et al.[21].

No significant differences were obtained in the maximal bite force after treatment at 2, 4, and 12 weeks. The same results were obtained in another study that was done in Turkey by Demirhan et al.[17]. In contrast, Yun et al. revealed that when compared to saline injections, the maximum biting force following botulinum neurotoxin-A injections showed a considerable reduction after 1 month or less[22].

There was a significant decrease in the tragus-angle line after treatment. In agreement, the same results were obtained in another study that was done in Korea by Hwa-Jin et al.[21]. This agreed with the results of another study that was done in Turkey by Demirhan et al[17].

In the current study, three patients had smile limitations at 12 weeks post-injection, while none of them showed masticatory fatigue or smile asymmetry as revealed in another study that was done by Fernanda et al.[18]. In agreement Kasturi et al. concluded that botulinum neurotoxin-A for patients with masseter muscle hypertrophy maintains an acceptable facial contour without any noticeable early- or late-post-injection problems[20].

CONCLUSION

The botulinum neurotoxin-A can be used effectively and safely in the treatment of masseter muscle hypertrophy and was associated with a significant decrease in the diameter of the masseter muscle and tragus-angle line.

REFERENCES

1. Yamaguchi K, Tohara H, Hara K, Nakane A, Kajisa E, Yoshimi K, et al. Relationship of aging, skeletal muscle mass, and tooth loss with masseter muscle thickness. BMC Geriatrics. 2018;18(1):67.
2. Keser G, Bayrakdar IS, Pekiner FN, Çelik Ö, Orhan K. A deep learning approach for masseter muscle segmentation on ultrasonography. Journal of Ultrasonography. 2022;22(91):e204-e208.
3. Fromage G. The uses of botulinum toxin A in facial aesthetics. Journal of Aesthetic Nursing. 2020;9(10):414-419.
4. Mezey SE, Müller-Gerbl M, Toranelli M, Türp JC. The human masseter muscle revisited: First description of its coronoid part. Annals of Anatomy - Anatomischer Anzeiger. 2022;240:151879.
5. Kato K, Matsuda N, Takahata M, Sato T. Difference in measurement methods of masseter muscle function in healthy young adults; occlusal force meter and ultrasound imaging systems. Structure and Function. 2020;18(2):95-100.
6. Iwasaki M, Hirano H, Motokawa K, Shirobe M, Edahiro A, Ohara Y, et al. Interrelationships among whole-body skeletal muscle mass, masseter muscle mass, oral function, and dentition status in older Japanese adults. BMC Geriatrics. 2021;21(1):582.
7. Yeh YT, Peng JH, Peng HLP. Literature review of the adverse events associated with botulinum toxin injection for the masseter muscle hypertrophy. Journal of cosmetic dermatology. 2018;17(5):675-687.
8. Singh S, Shivamurthy DM, Agrawal G, Varghese D. Surgical management of masseteric hypertrophy and mandibular retrognathism. Natl J Maxillofac Surg. 2011;2(1):96-99.
9. Kundu N, Kothari R, Shah N, Sandhu S, Tripathy DM, Galadari H, et al. Efficacy of botulinum toxin in masseter muscle hypertrophy for lower face contouring. Journal of Cosmetic Dermatology. 2022;21(5):1849-1856.
10. Almukhtar RM, Fabi SG. The Masseter Muscle and Its Role in Facial Contouring, Aging, and Quality of Life: A Literature Review. Plastic and Reconstructive Surgery. 2019;143(1):39e-48e.
11. Shamshoddin DRBD. A Review on Botulinum Toxin Safety and Efficacy in Treatment of Blepharospasm and Hemifacial Spasm. IOSR Journal of Dental and Medical Sciences. 2021;20(2):28-37.
12. Spare NM, Mazuera-Mejia SM, Gehret JA. Trigeminal Neuralgias. In: Freedman MK, Gehret JA, Young GW, Kamen LB, editors. Challenging Neuropathic Pain Syndromes: Elsevier; 2018. p. 177-186.
13. Raman S, Yamamoto Y, Suzuki Y, Matsuka Y. Mechanism and clinical use of botulinum neurotoxin in head and facial region. Journal of Prosthodontic Research. 2023:JPR_D_22_00238.

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-23, June 2023
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14. Haroutounian S, Finnerup NB. Chapter 50 - Recommendations for Pharmacologic Therapy of Neuropathic Pain. In: Benzon HT, Raja SN, Liu SS, Fishman SM, Cohen SP, editors. Essentials of Pain Medicine (Fourth Edition): Elsevier; 2018. p. 445-456.e442.
15. Goetz LL, Klausner AP. Neurogenic Lower Urinary Tract Dysfunction. In: Cifu DX, editor. Braddom's Physical Medicine and Rehabilitation (Sixth Edition). Philadelphia: Elsevier; 2021. p. 389-406.e382.
16. Bianco E, Tagliabue R, Mirabelli L, Maddalone M. Assessment of Electromyographic Changes in a Patient with Masseter Hypertrophy and Muscle Pain after Botulinum Injections: A Case Report and 5 Months Follow-up. The Journal of Contemporary Dental Practice. 2022;23(2):226-231.
17. Diracoglu D, Sahbaz T, Alptekin K, Dogan N. Effects of ultrasound-assisted botulinum neurotoxin-A injection in patients with bruxism and masseter hypertrophy. Turk J Phys Med Rehabil. 2021;67(3):351-356.
18. Klein FHdMdS, Brenner FM, Sato MS, Robert FMBR, Helmer KA. Lower facial remodeling with botulinum toxin type A for the treatment of masseter hypertrophy. Anais brasileiros de dermatologia. 2014;89:878-884.
19. Kim N-H, Park R-H, Park J-B. Botulinum toxin type A for the treatment of hypertrophy of the masseter muscle. Plastic and Reconstructive Surgery. 2010;125(6):1693-1705.
20. Bhattacharjee K, Singh M, Bhattacharjee H. Extended effect after a single dose of type A botulinum toxin for asymmetric masseter muscle hypertrophy. Indian Journal of Plastic Surgery. 2015;48(02):196-199.
21. Lee H-J, Kim S-J, Lee K-J, Yu H-S, Baik H-S. Repeated injections of botulinum toxin into the masseter muscle induce bony changes in human adults: A longitudinal study. The Korean Journal of Orthodontics. 2017;47(4):222-228.
22. Chen Y, Tsai C-H, Bae TH, Huang C-Y, Chen C, Kang Y-N, et al. Effectiveness of Botulinum Toxin Injection on Bruxism: A Systematic Review and Meta-analysis of Randomized Controlled Trials. Aesthetic Plastic Surgery. 2023;47(2):775-790.