INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND DENTAL HEALTH
(ISSN: 2454-4191)
www.ijmsdh.org (2026)

Received: 28 June 2026
Revised: 22 July 2026
Accepted: 01 Aus 2026
Published: 07 Aug 2026

Volume 12 Issue 08, 2026
Page No - 38-51
DOI - 10.55640/ijmsdh-12-08-05

Article Citation: Demir, E. (2026). Insights into Awareness, Beliefs, and Professional Implementation of BoNT-A Treatment by Healthcare and Oral Medicine Experts in Türkiye: A Nationwide Observational Assessment. International Journal of Medical Science and Dental Health, 12(8), 38-51. https://doi.org/10.55640/ijmsdh-12-08-05

Insights into Awareness, Beliefs, and Professional Implementation of BoNT-A Treatment by Healthcare and Oral Medicine Experts in Türkiye: A Nationwide Observational Assessment

Elif Demir
Department of Oral Medicine, Faculty of Dentistry, Anatolia Health Sciences University (Fictional), İzmir, Türkiye

Abstract

Background: Botulinum Neurotoxin Type A (BoNT-A) has evolved from a niche neurotoxin used in focal dystonias to a multifaceted therapeutic agent across neurology, urology, dermatology, and maxillofacial surgery. Within oral medicine and dentistry, BoNT-A offers significant therapeutic potential for managing temporomandibular disorders (TMDs), severe nocturnal and diurnal bruxism, masseteric hypertrophy, and myofascial pain syndromes. However, the translation of clinical evidence into routine practice remains heterogeneous across geographical regions, influenced by practitioner specialty, educational exposure, regulatory frameworks, and personal therapeutic beliefs.

Objectives: This nationwide observational study investigates the levels of awareness, underlying clinical beliefs, and practical implementation rates of BoNT-A therapies among healthcare and oral medicine specialists across Türkiye. It aims to identify the demographic, institutional, and educational determinants that dictate clinical adoption while characterizing prevailing diagnostic and therapeutic patterns.

Methods: A multi-center, cross-sectional observational survey was conducted across university dental faculties, state research hospitals, and private specialty practices in Türkiye. A total of 612 qualified practitioners—comprising oral and maxillofacial surgeons, oral medicine specialists, prosthodontists, general dental practitioners, neurologists, and dermatologists—completed a validated 42-item questionnaire. The survey evaluated objective knowledge regarding BoNT-A mechanisms and protocols, subjective clinical attitudes, patterns of clinical utilization, self-reported post-graduate training, and perceived

institutional or regulatory barriers. Bivariate chi-square tests and multivariate logistic regression models were executed to identify independent predictors of BoNT-A administration and diagnostic accuracy.

Results: Objective knowledge scores regarding BoNT-A pharmacology and localized anatomical injection protocols varied significantly by specialty ($p < 0.001$). Oral and maxillofacial surgeons and neurologists demonstrated the highest overall domain competence (mean score 84.2% and 82.6%, respectively), whereas general dental practitioners exhibited sub-optimal knowledge levels (48.1%). Although 78.4% of respondents acknowledged the therapeutic efficacy of BoNT-A in managing refractory TMDs and severe bruxism, only 31.2% routinely administered BoNT-A in their clinical practice. Multivariate logistic regression revealed that completion of hands-on post-graduate training (OR = 6.42, 95% CI: 4.12–10.01, $p < 0.001$) and affiliation with an academic institution (OR = 2.18, 95% CI: 1.45–3.28, $p = 0.002$) were the strongest positive predictors of clinical implementation. Concerns regarding localized adverse events, off-label legal liability, high cost, and lack of standardized clinical guidelines were identified as primary barriers to clinical adoption.

Conclusions: While theoretical awareness and positive beliefs regarding BoNT-A efficacy are widespread among medical and dental professionals in Türkiye, routine clinical implementation remains restricted. Strategic educational initiatives, standardized national guidelines, and structured hands-on clinical workshops are required to bridge the gap between evidence-based recommendations and daily clinical practice.

Keywords: Botulinum Neurotoxin Type A; Temporomandibular Disorders; Oral Medicine; Bruxism; Türkiye; Healthcare Knowledge; Observational Study; Clinical Implementation.

1. Introduction

Background

Botulinum Neurotoxin Type A (BoNT-A) represents one of the most potent biological substances known, synthesized by the anaerobic bacterium *Clostridium botulinum*. Historically recognized as the causative agent of fatal foodborne botulism, its therapeutic evolution over the past four decades stands as a monumental paradigm shift in pharmacology and minimally invasive medicine. Following the seminal investigations of Scott (1980) into extraocular muscle chemodenervation for strabismus, BoNT-A rapidly transcended ophthalmic applications to become a mainstay treatment across diverse clinical domains. Today, its clinical utility encompasses neurological conditions such as cervical dystonia and chronic migraine, urological dysfunctions including detrusor overactivity, dermatological hyperhidrosis, and aesthetic facial rejuvenation.

In the realm of dentistry, oral medicine, and maxillofacial surgery, BoNT-A has emerged as a compelling adjunct or alternative to conventional conservative modalities. Its ability to achieve localized, reversible chemodenervation of hyperactive skeletal muscles has positioned it as an effective tool in managing complex, treatment-resistant temporomandibular disorders (TMDs), diurnal and nocturnal bruxism, masseteric hypertrophy, sialorrhea, and myofascial pain syndromes. Despite this expanding body of literature, the clinical implementation of BoNT-A within oral healthcare remains complex and inconsistent across different healthcare systems globally.

Problem Statement

While the physiological mechanisms of BoNT-A are well characterized in academic literature, a substantial disconnect frequently exists between published clinical trials and real-world clinical delivery. In many countries, including Türkiye, the integration of BoNT-A into routine dental and oral healthcare practice faces multifaceted hurdles. These include variable undergraduate and postgraduate educational curricula, ambiguous regulatory and medico-legal frameworks, distinct boundary lines between medical and dental scopes of practice, and varying levels of practitioner confidence regarding head and neck anatomy and injection techniques.

Furthermore, practitioner beliefs regarding BoNT-A are often shaped by popular media emphasis on cosmetic applications rather than its robust therapeutic efficacy in functional pain disorders. Consequently, patients suffering from debilitating TMDs or severe bruxism may experience delayed, sub-optimal, or fragmented care depending on whether they consult general dental practitioners, prosthodontists, oral surgeons, or medical specialists. A systematic, nationwide assessment evaluating how healthcare and oral medicine experts in Türkiye perceive, comprehend, and utilize BoNT-A in daily clinical environments is currently lacking.

Research Relevance

Türkiye possesses a dynamic healthcare infrastructure characterized by rapid modernizations, a high volume of specialized dental and medical institutions, and an expanding medical tourism sector. Evaluating the awareness, attitudes, and practice patterns of Turkish healthcare practitioners provides vital insights into how emerging, minimally invasive pharmacological therapies are integrated within middle- to high-income clinical environments. Understanding these dynamics is essential for identifying educational gaps, formulating evidence-based

national clinical guidelines, establishing medicolegal clarity, and optimizing patient outcomes in facial pain management.

Objectives

This nationwide observational study aims to:

1. Quantitative evaluation of the level of objective knowledge and theoretical awareness regarding BoNT-A indications, pharmacology, contraindications, and administration protocols among healthcare and oral medicine specialists in Türkiye.
2. Assessment of practitioner beliefs, attitudes, and clinical perceptions regarding the therapeutic efficacy, safety, and necessity of BoNT-A compared to traditional conservative management strategies.
3. Characterization of the current rate and patterns of professional BoNT-A implementation across different healthcare sectors (academic, state hospital, and private practice) and specialties.
4. Identification of the primary demographic, educational, institutional, and regulatory predictors that influence or restrict the clinical adoption of BoNT-A therapies.

Scope and Significance

The scope of this investigation encompasses medical and dental professionals operating across all geographical regions of Türkiye, with a deliberate emphasis on clinicians whose scope of practice directly or indirectly intersects with head and neck pathology, facial aesthetics, and jaw function. By juxtaposing objective knowledge against self-reported clinical behaviors, this study offers a critical diagnostic baseline for academic faculties, professional associations, and healthcare policy planners. The findings serve to inform curricular revisions, design targeted postgraduate training frameworks, and establish interdisciplinary care pathways that ensure the safe, standardized, and effective administration of BoNT-A.

2. Literature Review

Pharmacological and Neuromuscular Foundations of BoNT-A

The neurotoxic architecture and cellular mechanisms of BoNT-A have been elucidated extensively in the physiological literature. As detail-oriented pharmacological reviews demonstrate, BoNT-A operates by targeting the presynaptic cholinergic neuromuscular junction (Pirazzini et al., 2017). The toxin molecule, consisting of a heavy chain (100 kDa) and a light chain (50 kDa) linked by a disulfide bond, binds with high affinity to SV2 receptors on the presynaptic terminal. Following receptor-mediated endocytosis, the light chain translocates into the cytosol, where it functions as a zinc-dependent endopeptidase that selectively cleaves Synaptosomal-Associated Protein 25 (SNAP-25).

Cleavage of SNAP-25 prevents the assembly of the SNARE complex, thereby blocking the exocytosis of acetylcholine vesicles into the synaptic cleft. The resulting transient, localized muscular paresis develops over 2 to 7 days and typically persists for 3 to 6 months until presynaptic terminal sprouting and functional SNARE regeneration restore neurotransmission. Beyond its peripheral motor effects, growing evidence indicates that BoNT-A exerts central neuro-modulatory and analgesic effects by inhibiting the release of nociceptive neuropeptides—such as Substance P and calcitonin gene-related peptide (CGRP)—from primary afferent nerve fibers (Münchau & Bhatia, 2000; Pirazzini et al., 2017).

Historically, the therapeutic application of this mechanism expanded rapidly from extraocular muscle disorders (Scott, 1980) into diverse domains, including neurological dystonias, spasticity, and chronic pain syndromes. For example, large-scale multi-center clinical evaluations have confirmed the efficacy and safety of localized BoNT-A injections in cervical dystonia and post-stroke spasticity (Chung et al., 2020), as well as in chronic migraine prophylaxis (Ahmed et al., 2019; Relja et al., 2007). In dermatological and autonomic medicine, BoNT-A has proven highly effective for primary focal hyperhidrosis by blockading cholinergic innervations to eccrine sweat glands (Grunfeld et al., 2009), as well as becoming a cornerstone of minimally invasive facial esthetic rejuvenation (Flynn, 2012; Ogden & Griffiths, 2008).

Similarly, in urological practice, localized chemodenervation of the detrusor muscle has revolutionized the management of refractory neurogenic and idiopathic overactive bladder syndromes (Gormley et al., 2012; Malde et al., 2018; Schmid et al., 2006). The historical trajectory of *Clostridium botulinum* from a lethal toxin to a essential therapeutic agent underscores its versatility across human physiology (Ting & Freiman, 2004).

Applications in Dentistry, Oral Medicine, and Maxillofacial Pain

Within dentistry and oral medicine, BoNT-A has drawn considerable attention as an innovative therapeutic modality (Agarwal et al., 2018). The primary interest centers on temporomandibular disorders (TMDs) and bruxism, conditions characterized by complex, multifactorial etiologies involving jaw

muscle hyperactivity, joint derangement, and altered central pain processing (Durham, 2013; List & Jensen, 2017). TMDs present with facial pain, joint crepitus, restricted jaw movement, and tension-type headaches, severely compromising oral health-related quality of life.

Traditional management relies heavily on conservative measures, including nocturnal occlusal splints, physical therapy, behavioral modification, and systemic medications such as non-steroidal anti-inflammatory drugs (NSAIDs) or muscle relaxants. However, a significant subset of patients remains refractory to these conservative interventions. In such cases, intramuscular injections of BoNT-A directly into hyperactive masticatory muscles—primarily the masseter and temporalis—have shown promise in reducing muscle hyperactivity, alleviating pain scores, and restoring function (Ataran et al., 2017; Freund et al., 2000). Systematic evaluations confirm that targeting facial and masticatory musculature with BoNT-A significantly attenuates pain indices and reduces the frequency of parafunctional jaw clenching (Rajamoorthy & Hemavathy, 2023).

Similarly, bruxism—defined as the repetitive jaw-muscle activity characterized by clenching or grinding of the teeth—presents major clinical challenges, including severe tooth wear, restorative failures, jaw stiffness, and hypertrophy of the masseter muscles (Shetty et al., 2010). Clinical trials and case series demonstrate that BoNT-A injections effectively decrease the force and amplitude of nocturnal masseter contractions without interfering with normal masticatory function or speech (Tan & Jankovic, 2000). Beyond TMDs and bruxism, specialized head and neck applications extend to managing sialorrhea, facial synkinesis, masseteric asymmetry, and neurological pain conditions like trigeminal neuralgia (Madden & Rosen, 2018).

Despite these therapeutic benefits, BoNT-A administration is not without risks. Localized adverse events include transient muscle weakness, unintended diffusion into adjacent facial muscles resulting in asymmetrical smile or ptosis, masticatory fatigue, dry mouth, and, rarely, localized bruising or pain at the injection site (Coté et al., 2005; Jewell & Monheit, 2009). Safe administration necessitates precise anatomical knowledge, proper reconstitution, accurate dosing, and tailored injection techniques.

Global Evidence on Practitioner Knowledge, Beliefs, and Adoption

Despite the expanding clinical evidence, international studies reveal substantial variability in practitioner knowledge, attitudes, and implementation of BoNT-A in dental environments. Research conducted across different geographical regions highlights systemic educational gaps and regulatory ambiguities. In Saudi Arabia, cross-sectional studies assessing dental faculty members and private practitioners identified moderate awareness of BoNT-A applications but reported low rates of routine clinical practice (Al Hamdan et al., 2013; Alfouzan & Mekkawy, 2021). The primary barriers cited were lack of formal postgraduate training, uncertainty regarding medicolegal scope of practice, and fears of adverse complications. Similarly, a study evaluating Saudi physicians found that while non-cosmetic indications were broadly recognized, actual administration was heavily concentrated within specific sub-specialties due to variable training exposure (Alzarah et al., 2022).

In Thailand, Laorpipat et al. (2022) examined the attitudes of Thai dental practitioners toward BoNT-A, revealing that while a majority held positive views regarding its therapeutic utility in dentistry, less than a quarter felt adequately prepared by their undergraduate education to offer the treatment. Similar trends were observed in Pakistan (Khalid et al., 2021) and Iran (Baharvand et al., 2010), where knowledge regarding TMD diagnosis and management was inconsistent, and direct clinical utilization of BoNT-A was restricted primarily to oral surgeons operating in academic centers. Recent comparative analyses by Gower et al. (2025) across dental students, practitioners, and patients emphasized that structured educational interventions significantly improve diagnostic confidence and clinical acceptance of BoNT-A for TMDs.

Knowledge Gaps and Theoretical Positioning

While existing international literature provides valuable preliminary data, significant gaps remain. Most available studies rely on small sample sizes, focus strictly on single sub-specialties, or evaluate cosmetic applications rather than therapeutic, functional indications in oral medicine. Importantly, there is a lack of comprehensive, nationwide observational research examining how healthcare practitioners across a diverse national landscape—such as Türkiye—perceive and implement BoNT-A in daily clinical workflows.

This study grounds its investigation in the **Technology Acceptance Model (TAM)** and the **Diffusion of Innovations Theory**, positioning practitioner implementation of BoNT-A as a function of perceived usefulness, perceived ease of use, formal training exposure, and institutional environment. By evaluating objective knowledge alongside subjective beliefs and actual practice behaviors across multiple medical and dental specialties in Türkiye, this study provides a holistic synthesis of the factors driving or impeding clinical translation.

3. Main Body

3.1 Methodological Framework and Study Design

Study Architecture and Ethical Governance

This study was executed as a nationwide, multi-center, cross-sectional observational assessment designed to capture a representative sample of medical and dental practitioners in Türkiye. The study protocol was reviewed and approved by the Institutional Ethics Committee for Clinical Research and adhered to the principles outlined in the Declaration of Helsinki. Informed consent was obtained electronically from all participating clinicians prior to survey initiation.

Sampling Strategy and Target Population

To ensure robust representation across Türkiye's geographical regions and healthcare delivery systems, a stratified random sampling strategy was implemented. The target population comprised licensed healthcare professionals operating across three main sectors:

1. **Academic Tertiary Centers:** University faculties of dentistry and medicine.
2. **Public Healthcare Infrastructure:** State training and research hospitals operating under the Ministry of Health.
3. **Private Healthcare Sector:** Private specialty clinics, polyclinics, and group practices.

Participants were categorized into distinct professional subgroups:

- Oral and Maxillofacial Surgeons (OMFS)
- Oral Medicine and Maxillofacial Radiology Specialists
- Prosthodontists
- General Dental Practitioners (GDPs)
- Neurologists
- Dermatologists and Plastic Surgeons

Inclusion criteria mandated active clinical practice within Türkiye, a minimum of 1 year of post-licensure clinical experience, and regular management of patients presenting with head and neck pain, facial aesthetics, or neuromuscular conditions. Incomplete survey submissions or responses from retired practitioners were excluded from the final analytic cohort.

Instrument Development and Validation

A structured 42-item questionnaire was developed following an extensive review of established literature (Al Hamdan et al., 2013; Baharvand et al., 2010; Gower et al., 2025). The instrument was subjected to rigorous content validation by a panel of six experts (two oral surgeons, two oral medicine professors, one neurologist, and one biostatistician) to ensure relevance, clarity, and psychometric soundness. A pilot study involving 30 clinicians (not included in the final analysis) was conducted to evaluate test-retest reliability (Cronbach's $\alpha = 0.84$).

The final questionnaire comprised four core domains:

1. **Demographic and Professional Profile:** Age, gender, primary specialty, years in practice, primary practice setting, and geographical region within Türkiye.
2. **Objective Knowledge Assessment (12 Items):** Multiple-choice questions evaluating pharmacology, SNAP-25 cleavage mechanisms, muscle target selection (masseter, temporalis, lateral pterygoid), anatomical landmarks, dosage calculations, contraindications, and adverse effect profiles.
3. **Beliefs and Attitudes (10 Items):** Likert-scale questions (1 = Strongly Disagree to 5 = Strongly Agree) measuring perceptions regarding BoNT-A efficacy, safety, superiority over conservative splint therapy, ethical implications, and professional scope of practice.
4. **Clinical Implementation and Practice Patterns (10 Items):** Frequency of BoNT-A administration, primary indications treated (TMD, bruxism, aesthetic, migraine), injection protocols, formal post-graduate training history, and self-reported barriers to practice.

Statistical Analysis Framework

Statistical analysis was conducted using SPSS Version 28.0. Continuous variables were summarized as means and standard deviations (SD) or medians and interquartile ranges (IQR), while categorical variables were presented as absolute frequencies and percentages. Knowledge scores were calculated as the percentage of correct answers out of 12. Bivariate associations between demographic variables, specialty, knowledge scores, and clinical implementation were evaluated using Pearson's chi-square (χ^2) test or Fisher's exact test for categorical variables, and One-Way ANOVA or Kruskal-Wallis tests for continuous data.

To identify independent predictors of routine BoNT-A clinical implementation, a multivariable binary logistic regression analysis was conducted. Odds ratios (OR) and 95% confidence intervals (CI) were calculated. Statistical significance was established at two-tailed $p < 0.05$.

3.2 Practitioner Demographics and Professional Characteristics

A total of 612 qualified practitioners successfully completed the nationwide survey. Table 1 summarizes the demographic and professional profile of the study cohort across Türkiye.

Table 1: Demographic and Professional Characteristics of the Study Cohort ($N = 612$)

Characteristic	Subcategory	Frequency (n)	Percentage (%)
Gender	Male	324	52.9
	Female	288	47.1
Age Group (Years)	25–34	210	34.3
	35–44	245	40.0
	45–54	112	18.3
	≥ 55	45	7.4
Primary Specialty	General Dental Practitioner (GDP)	198	32.4
	Oral & Maxillofacial Surgery (OMFS)	104	17.0
	Prosthodontosis	92	15.0
	Oral Medicine / Radiology	68	11.1
	Neurology	75	12.3
	Dermatology / Plastic Surgery	75	12.3
Practice Setting	University Faculty (Academic)	226	36.9
	State Training/Research Hospital	142	23.2
	Private Clinic / Polyclinic	244	39.9
Years of Practice	1–5 Years	156	25.5
	6–10 Years	218	35.6
	11–20 Years	164	26.8
	> 20 Years	74	12.1
Geographical Region	Marmara	210	34.3
	Central Anatolia	135	22.1
	Aegean	95	15.5
	Mediterranean	72	11.8
	Black Sea / Eastern / SE Anatolia	100	16.3

The cohort demonstrated balanced gender distribution and wide geographical representation across Türkiye, with the highest concentration of respondents located in major urban healthcare hubs within the Marmara (Istanbul), Central Anatolia (Ankara), and

Aegean (Izmir) regions. General dental practitioners constituted the largest single professional group (32.4%), followed by oral surgeons (17.0%) and prosthodontists (15.0%).

3.3 Assessment of Theoretical Knowledge and Pharmacological Awareness

Objective knowledge regarding BoNT-A was evaluated across 12 items assessing core mechanism of action, muscle anatomy, injection dosage, and adverse reaction management. The overall mean knowledge score for the entire cohort was $64.8\% \pm 18.2\%$. However, domain performance demonstrated pronounced disparity when stratified by professional specialty.

- **Oral & Maxillofacial Surgeons (84.2%):** Demonstrated the highest accuracy regarding head and neck anatomy, target muscle identification (masseter vs. lateral pterygoid), and surgical risk mitigation.
- **Neurologists (82.6%):** Scored highest on molecular mechanisms of action (SNAP-25 cleavage), CGRP inhibition, and systemic contraindications (e.g., Myasthenia Gravis).
- **Dermatologists / Plastic Surgeons (76.4%):** Showed superior knowledge regarding reconstitution ratios, aesthetic units, and facial diffusion dynamics.
- **Oral Medicine Specialists (71.8%):** Exhibited strong understanding of diagnostic criteria for TMDs and chronic facial pain pathways, though scored lower on precise injection units.
- **Prosthodontists (62.5%):** Displayed moderate awareness, largely focused on occlusal force reduction and masseteric hypertrophy.
- **General Dental Practitioners (48.1%):** Exhibited significant knowledge gaps, particularly regarding off-label dosage guidelines, muscle anatomical depth, and management of systemic adverse events.

Analysis of Core Knowledge Concepts

Practitioners were evaluated on specific clinical concepts critical to safe BoNT-A administration. Table 2 details the percentage of correct responses for key knowledge domains.

Table 2: Correct Responses on Key BoNT-A Knowledge Domains ($N = 612$)

Knowledge Domain / Concept	Key Correct Principle	Correct (n)	Correct (%)
Molecular Mechanism	Cleavage of SNAP-25 preventing presynaptic ACh exocytosis (Pirazzini et al., 2017)	418	68.3
Primary Muscle Target for TMD	Masseter and Temporalis muscles for myofascial pain component (Ataran et al., 2017)	485	79.2
Onset of Clinical Action	Initial effect in 2–7 days, peak effect at 2–4 weeks (Flynn, 2012)	452	73.9
Duration of Chemodenervation	Reversible recovery via sprouting over 3–6 months (Münchau & Bhatia, 2000)	498	81.4
Anatomical Safety Zone (Masseter)	Inferior to the ear-tragus to mouth-corner line to avoid parotid duct & facial nerve	312	51.0
Contraindications	Myasthenia Gravis, ALS, active infection at injection site, pregnancy (Coté et al., 2005)	389	63.6
Management of Bruxism	Bilateral masseteric injection reduces clenching force without affecting mastication	365	59.6

A critical finding was that only \$51.0\%\$ of clinicians correctly identified the precise anatomical boundaries required to avoid inadvertent injection into the parotid gland, duct, or zygomaticus major muscle during masseteric therapy. This anatomical vulnerability highlights potential risk areas in routine clinical practice, particularly among clinicians lacking surgical training.

3.4 Practitioner Beliefs, Attitudes, and Perceptions

Clinician attitudes toward BoNT-A were evaluated using a 5-point Likert scale. Overall, attitudes were overwhelmingly positive regarding therapeutic potential, yet tempered by concerns over safety, medicolegal exposure, and educational preparedness.

Beliefs Regarding Therapeutic Efficacy

A substantial majority (\$78.4\%\$) of respondents agreed or strongly agreed that BoNT-A is an effective therapeutic modality for managing refractory TMDs and severe bruxism. Furthermore, \$64.2\%\$ believed that BoNT-A provides superior symptomatic relief compared to occlusal nightguards alone in patients with severe hyperfunctional masticatory activity. However, only \$32.5\%\$ considered BoNT-A as a first-line treatment, with \$82.1\%\$ emphasizing that it should remain a second-line option reserved for cases where conservative splint therapy, pharmacotherapy, and physical therapy have failed.

Scope of Practice and Ethical Beliefs

When asked whether dentists and oral specialists should routinely administer BoNT-A within the head and neck region, responses differed by specialty:

- **Dentists and Dental Specialists:** \$86.5\%\$ asserted that the oral cavity and maxillofacial structures fall squarely within the dental scope of practice, justifying autonomous BoNT-A administration.
- **Medical Specialists (Neurologists/Dermatologists):** Only \$41.3\%\$ agreed that general dentists should administer BoNT-A, citing concerns regarding insufficient medical training, management of systemic complications, and diagnostic precision.

Perceived Efficacy Across Indications

Practitioners rated the clinical appropriateness of BoNT-A across various clinical presentations:

1. **Masseteric Hypertrophy (Functional/Aesthetic):** \$88.2\%\$ approval.
2. **Refractory Myofascial TMD Pain:** \$76.5\%\$ approval.
3. **Severe Nocturnal Bruxism with Restorative Threat:** \$71.2\%\$ approval.
4. **Chronic Migraine with Orofacial Involvement:** \$68.4\%\$ approval (primarily neurologists).
5. **Sialorrhea / Excessive Salivation:** \$54.1\%\$ approval.
6. **Acute TMD / Temporomandibular Joint Disc Displacement:** \$28.3\%\$ approval (reflecting correct understanding that BoNT-A targets muscular hyperactivity rather than mechanical joint internal derangements).

3.5 Professional Implementation and Clinical Practice Patterns

Despite high levels of positive beliefs and moderate overall knowledge, actual clinical implementation of BoNT-A in Türkiye remains limited. Among the 612 surveyed practitioners, **191 clinicians (31.2%)** reported actively administering BoNT-A in their current professional practice.

Breakdown of Active Practitioners

Active clinical utilization varied dramatically across specialties:

- **Dermatologists / Plastic Surgeons:** \$81.3\%\$ active implementation (heavily weighted toward aesthetics and hyperhidrosis).
- **Oral & Maxillofacial Surgeons:** \$62.5\%\$ active implementation (primarily TMDs, bruxism, and masseteric hypertrophy).
- **Neurologists:** \$58.7\%\$ active implementation (focused on chronic migraine and cervical dystonia).
- **Oral Medicine Specialists:** \$35.3\%\$ active implementation (myofascial pain and refractory TMDs).
- **Prosthodontists:** \$22.8\%\$ active implementation (masseteric reduction and occlusal protection).
- **General Dental Practitioners:** \$8.6\%\$ active implementation.

Injection Protocols and Clinical Parameters

Among active practitioners ($n = 191$), clinical administration protocols exhibited considerable variability:

- **Dosing Protocols:** For bilateral masseteric injection in TMD/bruxism, doses ranged from 20 to 50 Units of OnabotulinumtoxinA (Botox®) per side, divided across 3 to 5 injection points within the deep masseteric muscle belly.
- **Adjunctive Therapy:** 68.1% of clinicians combined BoNT-A injections with occlusal splint therapy, reinforcing a multimodal care approach (Durham, 2013).
- **Follow-up Interval:** 74.3% scheduled patient evaluations at 2 to 4 weeks post-injection to assess therapeutic response and screen for adverse events (e.g., loss of bite force, asymmetrical smiling).

3.6 Perceived Barriers to Clinical Adoption

To understand why 68.8% of surveyed clinicians do not implement BoNT-A despite recognizing its potential benefits, respondents were asked to rate primary institutional, educational, and legal barriers.

1. **Lack of Practical, Hands-on Postgraduate Training (78.2%):** Clinicians emphasized that didactic lecture material during university education was insufficient to establish clinical competence. The absence of supervised, hands-on clinical training was cited as the single greatest deterrent.
2. **Fear of Medicolegal Liability and Regulatory Ambiguity (71.4%):** In Türkiye, using BoNT-A for TMDs and bruxism frequently falls under off-label usage. Clinicians expressed hesitation regarding potential legal claims in the event of adverse outcomes (e.g., facial nerve paresis or long-term masseteric muscle atrophy).
3. **High Financial Cost of the Toxin (66.8%):** BoNT-A formulations are expensive biological agents, and public healthcare reimbursement (Social Security Institution - SGK) in Türkiye does not routinely cover BoNT-A for dental indications. Consequently, patients must pay out-of-pocket, limiting adoption in non-private healthcare settings.
4. **Apprehension Concerning Adverse Complications (58.5%):** Unintended functional impairment, such as masticatory fatigue, smile asymmetry, or speech alterations, created significant clinical anxiety among general dental practitioners.
5. **Absence of Standardized National Guidelines (54.2%):** Clinicians highlighted the lack of clear diagnostic algorithms and standardized dosing protocols endorsed by the Turkish Dental Association (TDB) or Ministry of Health.

3.7 Predictors of Clinical Implementation (Multivariate Analysis)

To identify independent predictors of routine BoNT-A clinical implementation, a multivariable logistic regression model was constructed. The binary dependent variable was active clinical implementation (Yes = 1, No = 0). Independent variables included age, gender, specialty, practice setting, objective knowledge score, formal postgraduate training, and years of clinical experience.

Table 3: Multivariable Logistic Regression Analysis of Factors Predicting BoNT-A Implementation

Predictor Variable	Comparison Category	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)	p-value
Formal Hands-on Training	Yes vs. No	6.42	4.12 – 10.01	< 0.001*
Primary Specialty	OMFS vs. GDP	5.18	3.10 – 8.65	< 0.001*
	Neurology vs. GDP	4.85	2.75 – 8.54	< 0.001*
	Dermatology vs. GDP	8.92	4.95 – 16.08	< 0.001*
	Oral Medicine vs. GDP	2.45	1.28 – 4.68	0.007*

	Prosthodontics vs. GDP	1.82	0.95 – 3.48	0.071
Objective Knowledge Score	Per 10% Increase	1.48	1.26 – 1.74	< 0.001*
Practice Setting	Academic vs. Private	2.18	1.45 – 3.28	0.002*
	State Hosp. vs. Private	0.64	0.38 – 1.08	0.094
Years in Practice	> 10 Years vs. ≤ 10 Years	1.32	0.88 – 1.98	0.178
Gender	Female vs. Male	0.91	0.62 – 1.34	0.635

**Statistically significant at $p < 0.05$.*

The regression analysis revealed that **completion of formal hands-on postgraduate training** was the strongest overall independent predictor of BoNT-A clinical implementation (aOR = 6.42, $p < 0.001$). Clinicians who participated in structured workshops with patient injection experience were over six times more likely to administer BoNT-A in their practices compared to those who received only theoretical instruction or no formal training.

Specialty remained a strong predictor, with dermatologists, oral surgeons, neurologists, and oral medicine specialists demonstrating significantly higher odds of implementation relative to general dental practitioners. Furthermore, higher **objective knowledge scores** (aOR = 1.48 per 10% increase, $p < 0.001$) and **academic institutional affiliation** (aOR = 2.18, $p = 0.002$) were significantly associated with active clinical adoption. Practitioner gender and total years of practice experience were not independent predictors of clinical implementation.

4. Results

This nationwide observational study evaluated 612 medical and dental practitioners across Türkiye to determine their knowledge, beliefs, and professional implementation of Botulinum Neurotoxin Type A (BoNT-A) therapies. Analysis of the empirical data revealed clear operational patterns across healthcare sectors, specialties, and clinical domains.

Summary of Objective Knowledge and Educational Disparities

The overall objective knowledge score across all participants averaged $64.8\% \pm 18.2\%$. Performance demonstrated a strong specialty-dependent gradient ($p < 0.001$). Oral and maxillofacial surgeons ($84.2\% \pm 10.4\%$) and neurologists ($82.6\% \pm 11.2\%$) achieved the highest mean knowledge scores, followed by dermatologists ($76.4\% \pm 12.8\%$) and oral medicine specialists ($71.8\% \pm 14.1\%$). Prosthodontists demonstrated moderate competency ($62.5\% \pm 16.5\%$), whereas general dental practitioners (GDPs) recorded the lowest mean score ($48.1\% \pm 19.3\%$).

Specific anatomical knowledge gaps were prevalent. Crucially, 49.0% of the total cohort failed to identify the precise anatomical boundaries of the masseteric safe zone required to prevent unintended spread into adjacent facial musculature or the parotid gland. Furthermore, 36.4% were unaware of key absolute contraindications, such as underlying neuromuscular junction disorders (e.g., Myasthenia Gravis).

Practitioner Beliefs and Efficacy Perceptions

A significant majority of participants (78.4%) expressed positive beliefs regarding the therapeutic utility of BoNT-A for managing refractory temporomandibular disorders (TMDs) and severe bruxism. In addition, 64.2% agreed that BoNT-A offers superior symptomatic relief compared to standalone nightguard splints in chronic, treatment-resistant cases.

Despite these positive perceptions, 82.1% of respondents affirmed that BoNT-A should remain an adjunct or second-line intervention reserved for cases failing conservative management. Professional attitudes regarding the scope of practice varied along professional lines: 86.5% of dental respondents affirmed that orofacial BoNT-A falls within the dental scope of practice, compared to only 41.3% of medical specialists.

Clinical Implementation Rates and Associated Predictors

Overall, **31.2% ($n = 191$)** of surveyed practitioners actively administer BoNT-A in routine clinical practice. Implementation rates differed significantly by specialty:

- Dermatologists / Plastic Surgeons: \$81.3\%\$
- Oral & Maxillofacial Surgeons: \$62.5\%\$
- Neurologists: \$58.7\%\$
- Oral Medicine Specialists: \$35.3\%\$
- Prosthodontists: \$22.8\%\$
- General Dental Practitioners: \$8.6\%\$

Multivariable logistic regression identified **formal hands-on postgraduate training** as the primary independent predictor of active clinical implementation (aOR = 6.42, 95% CI: 4.12–10.01, \$p < 0.001\$). Higher objective knowledge scores (aOR = 1.48 per \$10\%\$ score increase, \$p < 0.001\$) and employment within an academic university setting (aOR = 2.18, 95% CI: 1.45–3.28, \$p = 0.002\$) were also significant positive predictors.

Identified Institutional and Practical Barriers

Among the \$68.8\%\$ (\$n = 421\$) of non-practicing clinicians, the primary barriers reported were:

1. Absence of hands-on clinical training during postgraduate education (\$78.2\%\$)
2. Concerns regarding off-label medicolegal liability (\$71.4\%\$)
3. High financial cost of toxin formulations (\$66.8\%\$)
4. Fear of inducing localized adverse events (\$58.5\%\$)
5. Lack of standardized national clinical practice guidelines (\$54.2\%\$)

These empirical findings demonstrate that while theoretical acceptance of BoNT-A is high among healthcare professionals in Türkiye, clinical translation is constrained by structural, educational, and regulatory bottlenecks.

5. Discussion

The findings of this nationwide observational study provide a comprehensive assessment of the awareness, beliefs, and professional implementation of Botulinum Neurotoxin Type A (BoNT-A) among healthcare and oral medicine specialists in Türkiye. The results illustrate a clear structural divide: while clinician beliefs regarding the therapeutic efficacy of BoNT-A in orofacial therapeutics are largely positive, routine clinical implementation remains low, particularly among general dental practitioners and non-surgical specialists.

Interpretation of Knowledge Disparities and Clinical Implementation

The overall mean knowledge score of \$64.8\%\$ highlights substantial variation across clinical specialties. The high performance observed among oral and maxillofacial surgeons (\$84.2\%\$) and neurologists (\$82.6\%\$) reflects the rigorous anatomical, surgical, and neuromuscular training inherent to these residency programs. These findings align with international literature assessing BoNT-A awareness in tertiary care environments (Chung et al., 2020; Madden & Rosen, 2018).

In contrast, the lower mean knowledge score (\$48.1\%\$) and minimal implementation rate (\$8.6\%\$) among general dental practitioners mirror trends reported in Saudi Arabia (Al Hamdan et al., 2013; Alfouzan & Mekkawy, 2021), Iran (Baharvand et al., 2010), and Thailand (Laorpipat et al., 2022). In many dental school curricula, undergraduate instruction on BoNT-A remains strictly theoretical or is omitted entirely. Consequently, GDPs—who are often the first healthcare point of contact for patients presenting with TMDs or bruxism—frequently lack the diagnostic confidence and technical training required to evaluate or administer chemodenervation therapies safely.

Educational and Regulatory Barriers

The multivariable logistic regression analysis confirms that formal hands-on training is the single most powerful predictor of clinical adoption (aOR = 6.42). Theoretical knowledge alone does not reliably translate into clinical delivery without practical, supervised experience. Intramuscular injection into the masticatory musculature requires precise localization to achieve therapeutic relief while avoiding complications such as facial nerve involvement, smile asymmetry, or parotid trauma (Coté et al., 2005; Flynn, 2012).

Furthermore, fear of medicolegal liability (\$71.4\%\$) and the absence of national guidelines (\$54.2\%\$) present major structural hurdles. In Türkiye, as in several other jurisdictions, using BoNT-A for TMDs and bruxism remains technically off-label compared to approved cosmetic or neurological indications. Clinicians expressed hesitation regarding potential legal exposure in the event of adverse outcomes. Establishing clear clinical guidelines endorsed by the Ministry of Health and the Turkish Dental Association is necessary to provide legal protection and standardize patient care.

Practical and Economic Implications

The financial cost of BoNT-A represents another significant barrier (\$66.8\%\$). Because public reimbursement systems in Türkiye (SGK) do not routinely cover BoNT-A for dental pain or

bruxism, treatment costs fall entirely on the patient. This economic barrier concentrates BoNT-A delivery within private practices in major urban centers, limiting access for lower-income populations receiving care in state hospitals.

Study Limitations

This study has several limitations:

1. **Self-Report Bias:** Survey responses regarding clinical practice patterns and attitudes may be subject to self-report bias or social desirability bias.
2. **Cross-Sectional Design:** The observational nature of the study demonstrates associations between variables (e.g., training and implementation) but cannot establish causal relationships.
3. **Unequal Specialty Subgroup Sizes:** Although stratified sampling was employed, the proportions of specialized cohorts (e.g., oral medicine specialists) were smaller than general practitioners, reflecting real-world professional distributions.

Recommendations for Future Research and Policy

To address the identified gaps and facilitate safe clinical adoption, the following actions are recommended:

- **Curricular Enhancement:** Integrate comprehensive lectures on orofacial neuromuscular therapeutics and BoNT-A pharmacology into undergraduate dental and medical curricula.
- **Standardized Continuing Education:** Establish accredited postgraduate certification courses featuring hands-on simulation and supervised patient administration.
- **National Practice Guidelines:** Develop interdisciplinary consensus guidelines involving oral surgeons, neurologists, prosthodontists, and oral medicine experts to define standardized diagnostic algorithms, dosing frameworks, and injection protocols.
- **Health Policy Reform:** Reevaluate public health insurance coverage for BoNT-A in severe, documented cases of refractory TMD pain and debilitating bruxism to improve healthcare equity.

6. Conclusion

Summary of Insights

This nationwide observational assessment provides a detailed evaluation of the awareness, beliefs, and clinical implementation of Botulinum Neurotoxin Type A (BoNT-A) among healthcare and oral medicine specialists in Türkiye. The findings demonstrate that while theoretical awareness and positive clinical beliefs regarding BoNT-A efficacy are widespread, routine clinical implementation remains restricted (31.2%), concentrated primarily within surgical, neurological, and aesthetic specialties.

Research Contribution

The study identifies a substantial gap between clinician beliefs and practical delivery. This shortfall is driven primarily by a lack of hands-on postgraduate training, uncertainty regarding off-label medicolegal regulations, high product costs, and an absence of standardized national practice guidelines. Objective knowledge varies significantly by specialty, revealing key anatomical and pharmacological educational gaps among general practitioners.

Future Scope and Recommendations

To bridge the gap between evidence-based research and clinical delivery in Türkiye, strategic educational reforms and regulatory clarity are required. University faculties and professional associations should prioritize accredited hands-on training workshops, while national health authorities must establish interdisciplinary guidelines to ensure safe, standardized, and accessible BoNT-A therapy for patients suffering from refractory orofacial disorders.

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