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KNOWLEDGE, ATTITUDES, AND CLINICAL INTENTIONS OF DENTAL STUDENTS TOWARD BOTULINUM TOXIN USE: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background and Aim: Botulinum neurotoxin (BoNT) has gained increasing importance in dental practice for both therapeutic and aesthetic applications. However, its safe and effective use requires adequate knowledge and training. This study aimed to evaluate the knowledge, attitudes, and clinical intentions regarding the use of BoNT among dental students.

Materials and Methods: This cross-sectional study was conducted using an online, self-administered questionnaire distributed to dental students at two foundation universities in Turkey. The questionnaire assessed demographic characteristics, knowledge of BoNT (definition, indications, contraindications, and adverse effects), and attitudes toward its clinical use. Data were analyzed using descriptive statistics and Chi-square tests, with statistical significance set at $p < 0.05$.

Results: A total of 506 students participated. Only 34.4% of students correctly identified BoNT as a toxin, and 18.6% correctly identified all clinical indications of BoNT. Knowledge regarding contraindications was particularly limited, with only 2.8% answering correctly. Despite these gaps, 76.7% of students reported willingness to use BoNT in clinical practice, and 77.1% expressed interest in attending training courses. Students who expressed willingness to undergo BoNT injections themselves were significantly more likely to report willingness to administer BoNT clinically ($p < 0.05$). No consistent increase in knowledge levels was observed across academic years.

Conclusion: Dental students demonstrated limited knowledge of BoNT despite a high level of interest in its potential clinical use. These findings provide preliminary information regarding undergraduate dental students' awareness and perceptions of BoNT.

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INTRODUCTION

Botulinum neurotoxin (BoNT), produced by Clostridium botulinum, induces muscle paralysis by inhibiting the release of acetylcholine at the neuromuscular junction.[1] In dentistry, its use has expanded beyond aesthetic wrinkle reduction[2] to include the management of orofacial conditions such as temporomandibular disorders (TMD),[2] bruxism,[2] gummy smile,[3] and myofascial pain.[4] Although current evidence demonstrates high awareness of BoNT's cosmetic uses among healthcare professionals and students, significant knowledge gaps remain regarding its therapeutic indications, contraindications, and safety protocols.[5-8] Despite the increasing clinical relevance, BoNT-related education is not always formally integrated into undergraduate dental curricula,[6] and students may therefore seek information from non-scientific sources or social media.[9]

Although studies evaluating awareness of BoNT have been conducted across different populations,[6,9-11] comprehensive data on dental students' knowledge and attitudes in Turkey remain limited. The inclusion of students from all academic levels (first to fifth) in the present study was intended to assess baseline awareness as students progress from preclinical to clinical stages and to analyze potential changes in knowledge levels throughout the educational process.

Previous studies have reported that undergraduate students show considerable interest in advanced treatment modalities.[6,9-11] However, their knowledge regarding such applications may remain limited. Given that BoNT is generally considered an advanced or adjunctive treatment modality rather than a standard first-line approach in dental practice, understanding baseline awareness during undergraduate education is important for supporting its safe and evidence-based use in future clinical settings. Therefore, the present study aimed to evaluate dental students' baseline knowledge and attitudes regarding BoNT in dental practice and to explore how awareness of this treatment modality may vary across different stages of undergraduate dental education.

MATERIALS AND METHODS

This cross-sectional study was conducted as an online, self-administered questionnaire to evaluate the dental students' awareness, knowledge, and attitudes regarding BoNT. The study protocol was designed in accordance with the principles of the Declaration of Helsinki and was approved by the Istanbul Yeni Yuzyil University Non-Interventional Research Ethics Committee (Approval number: 2023/10-1101). Participation was voluntary, and electronic informed consent was obtained from all participants before data collection.

Participants were recruited between October and December 2023. The study population comprised dental students at two foundation universities in Turkey. According to records obtained from the student affairs offices of the participating universities, approximately 900 dental students were enrolled during the study period. The minimum required sample size was 258, based on a prevalence of 0.5, a 95% confidence level (α = 0.05), and a margin of error of ±0.05. Students from all academic years (first to fifth) were included to establish a baseline level of awareness, evaluate potential differences across stages of dental education, and provide insight into knowledge development during training.

The questionnaire was developed based on previously published studies,[6,8,9,12] with the main structure adapted from Coşkun et al.[12] and supplemented with clinical domains from other studies.[6,8,9] The questionnaire consisted of 12 items, grouped into five main sections: (1) demographic characteristics (gender and academic year), (2) basic knowledge of BoNT (definition of BoNT), (3) clinical indications (cosmetic and therapeutic applications), (4) contraindications and adverse effects, and (5) attitudes toward clinical use and professional training. Knowledge items evaluated participants' factual understanding of BoNT, whereas attitude items assessed personal preferences and clinical intentions regarding its potential use and training.

To ensure content validity, the questionnaire items were reviewed by two prosthodontists with academic and clinical experience in conditions such as bruxism, temporomandibular disorders, occlusal rehabilitation, and other clinical scenarios in which BoNT has been discussed as an adjunctive treatment modality. Their review focused on the relevance, clarity, and appropriateness of the questionnaire items for dental clinical practice. A pilot study was conducted with a small group of dental students, who were not included in the final analysis, to assess clarity, comprehension, and linguistic appropriateness. Minor revisions were made in response to participant feedback to improve clarity and eliminate ambiguity. Knowledge items included multiple-choice options and were scored based on correct responses, whereas attitude items were evaluated descriptively.

The questionnaire link was distributed through student communication networks using Google Forms. To ensure data validity and minimize selection bias, responses were limited to a single submission per participant through mandatory Google account authentication, preventing duplicate entries. As participants were recruited through voluntary participation via an online platform, the sampling approach is consistent with convenience sampling, and the possibility of selection bias cannot be entirely excluded.

Statistical analyses were performed using IBM SPSS Statistics version 27. Descriptive statistics (frequencies) were used to evaluate the study data. The Chi-square test and the Fisher-Freeman-Halton exact test were used to compare qualitative variables. Significance was assessed at the $p < 0.05$ level.

RESULTS

A total of 506 dental students completed the survey, corresponding to an approximate response rate of 56.2%. Of these participants, 310 (61.3%) were female and 196 (38.7%) were male. According to academic year, 23.7% were first-year students, 22.1% second-year students, 21.7% third-year students, 17.4% fourth-year students, and 15.0% fifth-year students.

Knowledge of BoNT

Overall, only 34.4% of the students correctly identified BoNT as a type of toxin. Only 18.6% correctly identified all clinical indications of BoNT. In response to the question "What is botulism?", 26.1% of the students correctly defined botulism as an infection caused by ingestion of Clostridium botulinum toxin through contaminated food. Only 2.8% of the students correctly identified both pregnancy/breastfeeding and neuromuscular diseases as contraindications for medical or cosmetic BoNT use. Regarding adverse effects, 52.6% of the students (n = 266) correctly selected all listed options (Table 1).

Comparison of knowledge levels according to academic year

A statistically significant difference was observed across academic years in responses to the question "What is Botox?" ($p = 0.001$). The highest correct response rate was observed among third-year students (54.5%), followed by fourth-year students (40.9%), both of which were significantly higher than those of first and second-year students ($p < 0.05$). A significant difference was also observed across academic years in responses to the clinical indications for BoNT ($p = 0.004$). Third-year students (30.9%) demonstrated significantly higher correct response rates than students from the other academic years ($p < 0.05$). Similarly, a statistically significant difference was observed for the definition of botulism ($p = 0.001$), with the highest correct response rate found among fifth-year students (52.6%). No significant differences were found across academic years in contraindications ($p > 0.05$). However, knowledge of adverse effects differed significantly across academic years ($p = 0.001$). Fourth-year students (6.8%) and fifth-year students (34.2%) demonstrated significantly lower correct response rates compared to first, second, and third-year students ($p < 0.05$) (Table 2).

Attitudes of BoNT

Overall, 76.7% of the students reported that they would consider administering BoNT in clinical practice. The main reasons for not considering BoNT were perceiving it as unnecessary and concerns about possible side effects. Most students (77.1%) indicated that they would consider attending a training course on BoNT applications. Additionally, 47.4% reported willingness to undergo BoNT injections themselves. Among those who indicated they would not consider undergoing BoNT injections, the most common reason was perceiving it as unnecessary (Table 3).

Female students reported significantly higher willingness to administer BoNT in clinical practice, attend training courses, and undergo BoNT injections than male students ($p = 0.001$; $p < 0.05$) (Table 4).

Students who reported that they would consider undergoing BoNT injections themselves were significantly more likely to report willingness to administer BoNT in clinical practice (89.2%) compared to those who would not (65.4%) ($p = 0.001$; $p < 0.05$).

DISCUSSION

BoNT, a potent neurotoxin produced by Clostridium botulinum, exerts its effect by inhibiting acetylcholine release at the neuromuscular junction.[13] Although widely used in cosmetic and medical applications, its administration requires adequate knowledge of indications, contraindications, and potential adverse effects to ensure patient safety.

The present study evaluated dental students' knowledge and attitudes toward BoNT at two foundation universities in Turkey. The findings indicate that knowledge levels were

Table 1. Distribution of students' responses to questions assessing knowledge of BoNT

		n	%
What is BoNT?	It is a kind of filler	312	61.7
	It is a kind of toxin*	174	34.4
	I don't know	20	4
Which are the indications of BoNT?	I don't know	52	10.3
	Facial rhytids	412	81.4
	Gummy smile	302	59.7
	Strabismus	135	26.7
	Cervical dystonia	174	34.4
	Migraine	218	43.1
	Blepharospasm	186	36.8
	Urinary incontinence	152	30
	Hemifacial spasm	110	21.7
	Hyperhidrosis	246	48.6
	Children with cerebral palsy	104	20.6
	Bruxism	292	57.7
	Trigeminal neuralgia	132	26.1
	Masseter hypertrophy	185	36.6
	Myofascial pain	140	27.7
	Trismus	148	29.2
	All*	94	18.6
What is botulism?	An infectious disease caused by ingestion of Clostridium botulinum bacterial toxin with food*	132	26.1
	Condition caused by spastic contraction of the muscles	70	13.8
	Condition characterized by paralysis of facial muscles in very cold weather	18	3.6
	I don't know	286	56.5
Who should not receive medical or cosmetic BoNT treatments?	Anyone aged between 18-65	52	10.3
	During pregnancy and breastfeeding	212	41.9
	Children	208	41.1
	For those with muscle diseases	148	29.2
	I don't know	134	26.5
	During pregnancy and breastfeeding / For those with muscle diseases*	14	2.8
Which are the adverse effects of BoNT?	Allergic reactions	430	85
	Weakness in adjacent muscles	382	75.5
	Localized stinging or burning pain during injection	360	71.1
	Photophobia	276	54.5
	Diplopia	294	58.1
	Incomplete eyelid closure	340	67.2
	Brow ptosis	310	61.3
	Eyelid ptosis (drooping eyelid)	326	64.4
	Facial asymmetry	348	68.8
	Pain	368	72.7
	Bruising	378	74.7
	Erythema	302	59.7
	Edema	378	74.7
	Tenderness	354	70
	Headache	316	62.5
	Infection	360	71.1
	All*	266	52.6
	I don't know	32	6.3

* Indicates the correct answer(s) for each question

Table 2. Comparison of correct response rates to knowledge questions on BoNT according to academic year

		First-year students	Second-year students	Third-year students	Fourth-year students	Fifth-year students	
		n (%)	n (%)	n (%)	n (%)	n (%)	p
What is BoNT?	False	88 (%73.3)	96 (%85.7)	50 (%45.5)	52 (%59.1)	46 (%60.5)	0.001*
	True	32 (%26.7)[b]	16 (%14.3)[a]	60 (%54.5)[c]	36 (%40.9)[bc]	30 (%39.5)[b]	
Which are the indications of BoNT?	False	102 (%85)	90 (%80.4)	76 (%69.1)	78 (%88.6)	66 (%86.8)	0.004*
	True	18 (%15)[a]	22 (%19.6)[a]	34 (%30.9)[b]	10 (%11.4)[a]	10 (%13.2)[a]	
What is botulism?	False	102 (%85)	98 (%87.5)	74 (%67.3)	64 (%72.7)	36 (%47.4)	0.001*
	True	18 (%15)[a]	14 (%12.5)[a]	36 (%32.7)[b]	24 (%27.3)[b]	40 (%52.6)[c]	
Who should not receive medical or cosmetic BoNT treatment?	False	118 (%98.3)	108 (%96.4)	106 (%96.4)	86 (%97.7)	74 (%97.4)	0.880
	True	2 (%1.7)	4 (%3.6)	4 (%3.6)	2 (%2.3)	2 (%2.6)	
Which are the adverse effects of BoNT?	False	44 (%36.7)	34 (%30.4)	30 (%27.3)	82 (%93.2)	50 (%65.8)	0.001*
	True	76 (%63.3)[c]	78 (%69.6)[c]	80 (%72.7)[c]	6 (%6.8)[a]	26 (%34.2)[b]	

Chi-square test +Fisher Freeman Halton Exact test *p<0.05
Different superscript letters (a, b, c) indicate statistically significant differences between academic years (p < 0.05), whereas groups sharing at least one common letter do not differ significantly.

limited while attitudes varied within the study population. Only 34.4% of students correctly identified BoNT as "a type of toxin", whereas 61.7% classified it as "a type of filler", suggesting a conceptual confusion between BoNT and dermal fillers. Furthermore, 56.5% of students were unaware of botulism, and only 26.1% answered the related question correctly. These findings indicate limited knowledge among the participants regarding the biological properties and microbiological origin of BoNT. Similarly, Uthayasankar et al.[10] reported that 43.9% of university students correctly identified BoNT as being derived from Clostridium botulinum, and that approximately 45.3% were aware of its association with botulism.

Coşkun et al.[12] also reported that botulinum toxin is frequently confused with dermal fillers. They found that 95.6% of sixth-year students correctly identified BoNT as a toxin, compared with 47.2% of first-year students, and further emphasized that this confusion between BoNT and dermal fillers was more common among students in the early years of education. However, no consistent increase in knowledge levels was observed across academic years in the present study. This finding may be related to the advanced and adjunctive nature of BoNT applications, which are not routinely encountered during undergraduate dental education, as well as differences in individual academic interests and engagement with the subject.

Questionnaire-based studies have shown that dental students possess a certain level of knowledge regarding the aesthetic applications of BoNT.[10,14-17] A study conducted in the United Kingdom reported that 89% of students had received no formal training in BoNT treatment,[15] whereas a study conducted in Chennai reported that 38% lacked sufficient knowledge of the risks associated with BoNT applications.[10] These findings are consistent with the results of the present study and highlight a discrepancy between knowledge of aesthetic applications and understanding of clinical safety parameters. This difference may be related to the greater visibility and familiarity of aesthetic procedures, while safety-related aspects such as contraindications and risk management require more detailed and structured understanding.

Al Hamdan et al.[8] reported that 73.7% of students stated that BoNT is effective in reducing wrinkles. Uthayasankar et al.[10] reported this rate as 50%. In contrast, Coşkun et al.[12] reported this rate to be 97.2%. Similarly, Gower et al.[6] reported that the cosmetic use of BoNT is widely

Table 3. Attitudes of dental students toward clinical and personal use of BoNT

		n	%
Would you consider administering BoNT to patients in your clinical practice?	Yes	388	76.7
	No	118	23.3
If you answered no, please indicate the reason(s) (n=118)	High cost	4	3.4
	Fear	16	13.6
	Not necessary	36	30.5
	Risk of adverse effects	25	21.2
	Religious reasons	16	13.6
	Concern about changes in facial expression	9	7.6
	Other	12	10.2
Would you consider attending a training course on BoNT applications?	Yes	390	77.1
	No	116	22.9
Would you consider undergoing BoNT injections yourself?	Yes	240	47.4
	No	266	52.6
If you answered no, please indicate the reason(s). (n=266)	High cost	10	3.8
	Fear	34	12.8
	Not necessary	184	69.2
	Risk of adverse effects	42	15.8
	Religious reasons	26	9.8
	Concern about changes in facial expression	36	13.5

recognized, whereas knowledge of its therapeutic use, such as for bruxism and temporomandibular disorders, remains more limited.

In the present study, 81.4% of students correctly identified wrinkle reduction as an indication for BoNT. However, only 18.6% correctly answered the indication question by selecting all correct options. This finding suggests that knowledge of BoNT indications may be selective rather than comprehensive, with stronger recognition of commonly known applications compared to the full spectrum of clinical uses. Furthermore, third-year students demonstrated significantly higher correct response rates, which may reflect differences in exposure to related theoretical concepts or in individual interest levels.

Knowledge of contraindications was notably limited, as only 2.8% of students correctly identified both pregnancy/breastfeeding and neuromuscular diseases as contraindications. This low rate indicates a notable limitation in participants' understanding of clinical safety, particularly in identifying key contraindications. Similarly, Imam et al.[11] reported that approximately two-thirds of students believed that BoNT injections may not be safe during pregnancy or breastfeeding. Although this rate remains below the ideal level, it is higher than the correct response rate observed in the present study.

Adverse effects associated with BoNT applications include allergic reactions, injection site infection, bruising, edema, and localized pain. More serious complications include

Table 4. Gender-based comparison of attitudes toward BoNT use

		Female	Male	
		n (%)	n (%)	p
Would you consider administering BoNT to patients in your clinical practice?	Yes	256 (%82.6)	132 (%67.3)	0.001*
	No	54 (%17.4)	64 (%32.7)	
Would you consider attending a training course on BoNT applications?	Yes	258 (%83.2)	132 (%67.3)	0.001*
	No	52 (%16.8)	64 (%32.7)	
Would you consider undergoing BoNT injections yourself?	Yes	192 (%61.9)	48 (%24.5)	0.001*
	No	118 (%38.1)	148 (%75.5)	

Chi-square test *p<0.05

muscle weakness, ptosis, dysphagia or respiratory difficulty, and unintended effects in adjacent muscle groups due to improper administration.[18] Thapa[19] reported that 51% of students were aware of the risks associated with BoNT procedures, whereas Uthayasankar et al.[10] reported this rate as 38%. In the present study, 52.6% of students correctly identified all adverse effects, with allergic reactions being the most recognized (85%).

Overall, the findings regarding differences across academic years did not demonstrate a consistent pattern of improvement. Although certain groups, particularly third-year students, demonstrated higher levels of knowledge in specific areas, this pattern was not consistent across all domains. This variability may indicate that knowledge about BoNT did not develop cumulatively or sequentially but rather fluctuates across different stages. Differences may influence such variability in exposure to related topics, individual learning patterns, or varying levels of engagement with the subject matter.

In the present study, 47.4% of students reported willingness to undergo BoNT injections themselves, whereas 52.6% indicated they would not, with the most frequently reported reason being that it was perceived as unnecessary. However, 76.7% of students reported considering using BoNT in clinical practice. This difference may suggest that personal preference regarding aesthetic procedures does not necessarily reflect professional interest, and that participants may recognize the potential role of BoNT in clinical settings despite limited personal inclination toward its use.

Gender-based differences were observed in willingness to undergo BoNT injections, with higher rates among female students. However, willingness to consider its clinical use was high in both groups. In addition, students who expressed willingness to undergo BoNT injections were more likely to report willingness to administer it in clinical practice, suggesting that personal inclination toward BoNT may influence professional attitudes toward its clinical use. Khan et al.[9] reported that 45.1% of participants would consider using BoNT in the future, 26.8% would not, and 28% were undecided. Additionally, 26.8% of participants reported that they would not consider undergoing BoNT injections, most of whom were between 21 and 25 years of age. These findings suggest that BoNT appears to be a commonly preferred aesthetic procedure, particularly among young adults, and are consistent with studies emphasizing its popularity for wrinkle reduction.[17]

However, it should be noted that BoNT is generally regarded as an advanced or adjunctive treatment modality; therefore, the appropriate level at which such education should be delivered - whether undergraduate, postgraduate, or continuing professional development - warrants further consideration.

This study has several limitations. First, the study population consisted of dental students from only two foundation universities in Turkey, which may limit the generalizability of the findings. Therefore, the results should be interpreted within the context of these institutions rather than representing all dental students. In addition, the evaluation of demographic variables was limited, as only basic characteristics such as gender and academic year were included, while other potentially relevant factors were not assessed. The use of an online, voluntary questionnaire may introduce selection bias, as students with greater interest in

the topic may be more likely to participate. The self-reported nature of the responses may not fully reflect the actual level of knowledge, and the use of predefined answer options may have influenced participants' responses and may not fully capture their true level of understanding. Furthermore, the study did not include postgraduate students or practicing clinicians for comparison, which may limit the interpretation of the findings across different levels of clinical experience. Future research with larger, multi-center samples may help to better evaluate knowledge levels and attitudes toward BoNT across different educational settings. Furthermore, the content validity of the questionnaire was assessed by prosthodontists only; inclusion of a broader multidisciplinary expert panel could have further strengthened the instrument.

CONCLUSION

Dental students included in this study demonstrated a high level of interest in the potential clinical use of BoNT despite limited knowledge, particularly regarding contraindications and clinical safety. In addition, knowledge levels did not show a consistent increase across academic years. These findings provide preliminary information regarding undergraduate dental students' awareness and perceptions of BoNT. Further studies involving postgraduate trainees and practicing clinicians may help clarify how knowledge and attitudes toward BoNT evolve across different stages of professional training and inform future educational discussions.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

ETHICS STATEMENT

The study was approved by the Istanbul Yeni Yuzyil University Non-Interventional Research Ethics Committee (Approval number: 2023/10-1101).

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