Evaluation of Antibiotic Prescribing Patterns in Paediatric Dental Patients: Cross - Sectional Epidemiological Study

SUMMARY

Background/Aim: The purpose of this study was to investigate the antibiotic prescribing patterns for the treatment of paediatric oral infection, dental trauma and prophylaxis among dentists in Turkey. **Material and Methods:** A total of 206 paediatric dentists, including general dentists, paediatric dentists and specialist dentists, participated in this cross-sectional study. The questionnaire included questions about the number of paediatric patients treated and antibiotics prescribed, the most commonly prescribed antibiotic for oral infections and the clinical conditions under which antibiotics were prescribed. The participants' ages, workplaces and professional experience were also evaluated. **Results:** The majority of the participants were paediatric dentists (45.1%) and general dentists (42.7%). For the management of dental infections, most dentists prescribed penicillin (94.7%). Their foremost prescription choices for the presence of an anaerobic infection were metronidazole (48.5%) and penicillin (32%). For dental trauma, the most common antibiotic-prescribed cases were avulsion and contaminated wounds, followed by alveolar fracture. Antibiotics were prescribed as a first choice for dental infections and dental infections of anaerobic origin, with no significant differences between professional experience or dental specialty in the dentists ($p > 0.05$). Practitioners belonging to Ministry of Health dental centres significantly differed from all other groups in preferring the antibiotic cephalosporin for dental infections of anaerobic origin. **Conclusions:** Adherence to published guidelines for antibiotic prescriptions for anaerobic dental infections and dental trauma was low. Clearer, more specific guidelines and increased post-graduate education could lead to a reduction in the negative consequences of this issue's resultant over-prescribed antibiotics.

Keywords: Antibiotics, Clinical Protocols, Guidelines

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Introduction

Antibiotics are the most commonly used medications for the treatment and prevention of bacterial infections¹. Using antibiotics can decrease infection time and reduce the risk of bacteraemia². However, the widespread use of antibiotics has allowed certain bacteria to develop resistance. Indeed, antibiotics resistance is increasing worldwide¹.

The Centers for Disease Control and Prevention (CDC) reported having 140,000 emergency applications every year due to antibiotic reactions, which are the most common causes of emergency visits for adverse drug events in paediatric patients³. Pallasch told that antibiotics help a host's immune system gain control and eliminate the infection but, in addition, they have many negative outcomes, such as toxicity, allergy, superinfection, chromosomal mutations, gene transfer to vulnerable organisms and the expression of dormant resistant genes⁴.

Dentists prescribe the third highest number of antibiotics in the nation by volume⁵, or 7–11% of all common antibiotics⁶. The essential factor in the distinction between medical and dental conditions is that most dental infections can be treated successfully by removing the reservoir of the infection^{7,8}. In the reachable literature, many studies have reported the systemic overuse of antibiotics in dentistry. In Turkey and Liverpool, 75% of patients^{9,10}; in Germany, 43% of patients¹¹; and in Britain, 30% of patients¹² are prescribed antibiotics improperly. Therefore, AAPD guidelines underscore conservative antibiotic use and have set out principles that practitioners must follow when prescribing antibiotics to the paediatric population.

Previous studies have examined antibiotic use in dentistry but, up to now, only a few have examined antibiotic use in the paediatric population. The aim of this study was thus to evaluate Turkish dentists' approach to antibiotic use in paediatric patients. In particular, the dentists' adherence to available professional guidelines was investigated.

Material and Methods

Questionnaires

Questionnaires for this cross-sectional study were distributed to 206 dental practitioners, including general dentists, paediatric dentists and specialist dentists. The dental practitioners worked in Ministry of Health dental centres, universities of dentistry or private dental practices in seven different regions of Turkey. The researcher made questionnaire form was prepared according to the AAPD's 'Use of antibiotic therapy for pediatric dental patients'¹³ and 'Antibiotic prophylaxis for dental patients at risk for infection' guidelines¹⁴. In a pilot study, the questionnaire was pretested on 20 participants afterward excluded from the study. Electronic data software (Google Forms) was utilized for both the survey's construction and data collection.

The questionnaire contained information pertaining to the following: number of paediatric patients treated, number of prescribed antibiotics, most common antibiotic prescribed for aerobic and non-aerobic infections, clinical conditions under which antibiotics were prescribed and awareness of antibiotic prophylaxis. Although the questionnaire was anonymous, the respondents were requested to provide demographic information such as age and workplace. They were also requested to indicate whether they have attended any courses about antibiotic use.

Statistical analysis

The statistical analysis was done using the Statistical Package for the Social Sciences, version 23 (IBM Corp.,

Armonk, NY, USA). This study's demographic data, given as number and percentage, was tabularized. Categorical variables were described by frequency (percentage) and compared using the chi-square test. If the number of cells with an expected value less than 5 amounted to more than 20%, the results were interpreted according to the "Pearson chi-square" instead of the "likelihood ratio chi-square". Significance was defined as p -value < 0.05.

Results

Of the 1,012 surveys sent, 206 (20.3%) were returned. Table 1 presents the practitioners' professional characteristics. The participants' professional experience rates were 35% for 10 or more years, 34% for 5–10 years and 31.1% for 5 years or less. Of the respondents, 42.7% worked at universities, 30.6% at Ministry of Health dental centres and 26.7% at private dental practices. The majority of the participants were paediatric dentists (45.1%) and general dentists (42.7%). Approximately 84% of the respondents found their antibiotics training sufficient, while nearly 52% reported not having attended any antibiotic use courses.

Table 1. Professional characteristics

Variables	n (%)
Professional experience	
> 10	72 (35.0)
5–10	70 (34.0)
< 5	64 (31.1)
Workplace	
University	88 (42.7)
Ministry of Health dental centres	63 (30.6)
Private dental practice	55 (26.7)
Dental specialty	
General dentist	88 (42.7)
Paediatric dentist	93 (45.1)
Specialty dentist	25 (12.1)
Do feel you have enough antibiotics education?	
Yes	32 (15.5)
No	174 (84.5)
Have you attended any antibiotic courses?	
Yes	98 (47.6)
No	108 (52.4)

Table 2. Practice characteristics

Variables	n (%)
How many child patients visit you on average?	
< 5 a day	93 (45.1)
5–10 a day	40 (19.4)
> 10 a day	73 (35.4)
How many child patients do you prescribe antibiotics to on average?	
None	13 (6.3)
1–4 a day	89 (43.2)
≥ 4 a day	12 (5.8)
1–5 a week	44 (21.4)
1–4 a month	48 (23.3)
What is the first antibiotic you prefer for dental infections?	
Penicillin	195 (94.7)
Cephalosporin	4 (1.9)
Macrolide	2 (1.0)
Clindamycin	5 (2.4)
Tetracycline	- (-)
What is your antibiotic of choice for dental infections of anaerobic origin?	
Penicillin	66 (32.0)
Cephalosporin	8 (3.9)
Macrolide	12 (5.8)
Clindamycin	9 (4.4)
Metronidazole	100 (48.5)
Tetracycline	2 (1.0)
Penicillin + Metronidazole	9 (4.4)
What is your antibiotic of choice for dental trauma?	
Crown fracture	4 (1.9)
Crown root fracture	29 (14.1)
Root fracture	39 (18.9)
Alveolar fracture	114 (55.3)
Concussion	9 (4.4)
Subluxation	21 (10.2)
Extrusion	65 (31.6)
Intrusion	68 (33)
Primary dentition injury	23 (11.2)
Avulsion	148 (71.8)
Contaminated wound	144 (69.9)
In which cases do you apply antibiotic prophylaxis?	
Prosthetic cardiac valve or prosthetic material used for cardiac valve repair	180 (87.4)
Patient with shunts, indwelling vascular catheters or other medical devices	137 (66.5)
Previous infective endocarditis	183 (88.8)
Unrepaired cyanotic congenital heart disease	138 (67)
Completely repaired congenital heart disease with prosthetic material or device during the first 6 months after the procedure	176 (85.4)
Cardiac transplantation recipients who develop cardiac valvulopathy	156 (75.7)
Autoimmune disease	85 (41.3)
Sickle cell anaemia	28 (13.6)
Chronic high-dose steroid usage	49 (23.8)
Uncontrolled diabetes mellitus	28 (13.6)
Bisphosphonate therapy	65 (31.6)
History of total joint arthroplasty	73 (35.4)
None	3 (1.5)
For which procedures do you apply prophylaxis?	
Manipulation of gingival tissue	114 (55.3)
Manipulation of periapical tooth region	141 (68.4)
Perforation of the oral mucosa	111 (53.9)
Routine anaesthetic injections through non-infected tissue	27 (13.1)
Placement of removable appliances	- (-)
Bleeding from trauma to the lips or oral mucosa	89 (43.2)
Shedding of primary teeth	11 (5.3)
None	45 (21.8)

The respondents' practice characteristics are shown in Table 2. The majority of the participants saw less than 5 (45.1%) or more than 10 (35.4%) children per day. Approximately 43% prescribed antibiotics to 1–4 children per day. For dental infection management, the majority of dentists prescribed penicillin (94.7%). Their first antibiotic choice for the presence of an anaerobic infection was metronidazole (48.5%), followed by penicillin (32%). For dental trauma, the most common antibiotic-prescribed cases were avulsion and contaminated wounds, following by alveolar fracture. In response to the questions on prescribing antibiotics for cases requiring prophylaxis, 88.8% of the respondents would prescribe them for previous infective endocarditis, 87.4% for prosthetic cardiac valve or cardiac valve repair material and 85.4% for completely repaired congenital heart disease with prosthetic material/devices for the first 6 months after the procedure. The respondents' most common procedure choices in the presence of antibiotic prophylaxis were manipulation of the periapical teeth region (68.4%), manipulation of gingival tissue (55.3%), perforation of the oral mucosa (53.9%) and bleeding from trauma to the lips or oral mucosa (43.2%).

The participants prescribed antibiotics as their first choice for dental infections and dental infections of anaerobic origin, with no significant differences between professional experience or dental specialty ($p > 0.05$; Tables 3). Practitioners from Ministry of Health dental centres' significantly differed from all groups in preferring the antibiotic cephalosporin for dental infections of anaerobic origin ($p < 0.05$; Table 3).

Table 4 shows a list of other non-clinical criteria that influenced the respondents' antibiotic prescriptions. In total, 67.3% of the participants did not prescribe antibiotics due to non-clinical conditions. Still, the presence of a fistula in the gingiva was the most common reason for prescribing antibiotics (20.4%). About 12.6% prescribed antibiotics when busy with appointments and 10.7% when the diagnosis was uncertain. Only a few practitioners prescribed antibiotics per parents' expectations for a prescription, when a patient was consulted and when the only symptom was pain.

Table 3. Percentage of practitioners' antibiotic preferences according to professional characteristics

	< 5 years	5–10 years	> 10 years
Dental infections*			
Penicillin	96.9	98.6	88.9
Cephalosporin	0	1.4	4.2
Macrolide	0	0	2.8
Clindamycin	3.1	0	4.2
Dental infections of anaerobic origin**			
Penicillin	43.8	24.3	29.2
Cephalosporin	1.6	5.7	4.2
Macrolide	3.1	10.0	4.2
Clindamycin	1.6	7.1	4.2
Metronidazole	43.8	47.1	54.2
Tetracycline	1.6	0	1.4
Penicillin + Metronidazole	4.7	5.7	2.8
	University	Ministry of Health dental centre	Private dental practice
Dental infections***			
Penicillin	97.7	93.7	90.9
Cephalosporin	0	4.8	1.8
Macrolide	0	0	3.6
Clindamycin	2.3	1.6	3.6
Dental infections of anaerobic origin			
Penicillin	30.7	36.5	29.1
Cephalosporin	1.1	11.1 [†]	0
Macrolide	5.7	9.5	1.8
Clindamycin	3.4	3.2	7.3
Metronidazole	53.4	33.3	58.2
Tetracycline	0	3.2	0
Penicillin + Metronidazole	5.7	3.2	3.6
	General dentist	Paediatric dentist	Specialty dentist
Dental infections[‡]			
Penicillin	92.0	96.8	96
Cephalosporin	3.4	1.1	0
Macrolide	1.1	1.1	0
Clindamycin	3.4	1.1	4
Dental infections of anaerobic origin[¶]			
Penicillin	36.4	29.0	28.0
Cephalosporin	8	1.1	0
Macrolide	4.5	6.5	8.0
Clindamycin	4.5	4.3	4.0
Metronidazole	42.0	53.8	52.0
Tetracycline	2.3	0	0
Penicillin + Metronidazole	2.3	5.4	8

*No differences among specialty groups (Pearson's chi-square test = 10.020; $p = 0.124$)**No differences among specialty groups (Pearson's chi-square test = 13.936; $p = 0.305$)***No differences among specialty groups (Pearson's chi-square test = 10.483; $p = 0.106$)[†] Significantly different from all groups ($p < 0.01$)[‡] No differences among specialty groups (Pearson's chi-square test = 3.516; $p = 0.742$)[¶] No differences among specialty groups (Pearson's chi-square test = 13.933; $p = 0.305$)

Table 4. Non-clinical criteria considerations

Variables	n (%)
Parents' expectations for a prescription	12 (5.8)
Busy appointments	26 (12.6)
Patient consultation	7 (3.4)
Diagnosis uncertain	22 (10.7)
The only symptom is pain	7 (3.4)
The only symptom is fistula	42 (20.4)
None	140 (67.3)

Discussion

In the accessible literature, there is no study about the use of antibiotics to treat dental infections in Turkish children, so this study was planned to address this research gap. The proportion of dentists who had attended a course or symposium on antibiotic treatment was equal to those who had not (47.6%). This rate is higher than in other studies¹⁵. This has been associated with an increase in both the number of antibiotic courses and the interest in these courses, as recently, due attention has been drawn to antibiotic resistance.

The gold standard for the treatment of dental infections has been penicillin until now due to its low toxicity, efficacy in polymicrobial infections, relatively narrow spectrum for bacteria, especially in endodontic infections, and low cost¹⁶⁻¹⁸. Penicillin was the most frequently prescribed antibiotic (94.7%) for dental infections that required an antibiotics regime, followed by clindamycin and cephalosporin, respectively. The reason for choosing clindamycin is thought to be patients with a penicillin allergy. Regardless of the participants' ages, workplaces or experience, their first antibiotic choice was penicillin. The most preferred antibiotic in dental infections caused by harbour anaerobic organisms were metronidazole (48.5%) and penicillin (32%). However, metronidazole alone has a low efficacy for odontogenic resistant infections¹⁷⁻¹⁹. Concomitant amoxicillin and metronidazole use is well-supported in the literature, especially in cases where it is thought to contain anaerobes^{20,21}. The AAPD indicates that penicillin remains an empirical option for odontogenic infections, though it has also suggested that additional adjuvant antimicrobial therapy (i.e. metronidazole) should be considered in cases of anaerobic bacterial involvement¹³. In our study, very few participants combined antibiotics. We assume that this forms a difference in the prescription of antibiotics between paediatric dentists and other dentists, as the first group has more comprehensive education on children. Still, we concluded that additional

vocational training is not a factor that contributes to compliance with prescription guidelines; similar findings were reported by Vasudavan *et al.*² and Cherry *et al.*²².

The AAPD and IADT approve the use of oral antibiotics in instances such as avulsed permanent tooth with an open or closed apex and concomitant soft tissue injuries, and when dictated by the patient's medical status^{13,23}. In our study, avulsion and contaminated tissue injuries were the most common trauma cases eliciting antibiotic prescriptions. However, it is quite often to see antibiotic use in other dental trauma cases. This study's results thus indicate a potential problem in how clinicians use antibiotics for dental trauma in children.

Infective endocarditis is an uncommon complication that can be life-threatening due to the presence of bacteraemia. In a multicentre study of American children's hospitals, the incidence of paediatric admissions due to infective endocarditis was reported as between 0.05 and 0.12 cases per 1,000 admissions from 2003 to 2010¹⁴. In our study, the participants recommended antibiotic prophylaxis for invasive dental procedures in the cardiac conditions given in the table. Except for patients with total joint prosthesis, other patients in this table are of high-risk and should be considered for prophylaxis, although there is insufficient data to support its use. Still, historically total joint arthroplasty does not require antibiotic use¹⁴. Looking at the study's results, we found that the application of antibiotic prophylaxis in the risk groups was insufficient. While the AAPD requires antibiotic prophylaxis for all dental procedures involving treatment of the gingiva tissue, periapical teeth region or perforation of the oral mucosa, it does not require antibiotic prophylaxis in the other procedures in the table. However, the number of participants who apply antibiotics in the necessary dental procedures was poor. These results support the need to publish clearer guidelines for antibiotic prophylaxis.

It is worth emphasizing that the majority of the respondents would not prescribe antibiotics for non-clinical criteria considerations, such as patient consultations, when the only symptom is pain or when parents expect a prescription. A significant percentage of especially toothache is due to acute and chronic pulpal infections that require surgical intervention rather than antibiotics²⁴. A small fraction of the respondents would prescribe antibiotics when a diagnosis was uncertain. This is due to the fear that a delayed response can lead to serious consequences. There were also participants who found empirical antibiotic therapy suitable when they were busy with appointments, regardless of whether such a drug was required. We assume that this may be related to high patient density. Surprisingly, though, about 20.4% of the patients would prescribe antibiotics when the only symptom was fistula, showing that some participants act inconsistently with the practices recommended by professional guidelines. Unless there is systemic

involvement, effective drainage and elimination of the infection agent sufficiently manage simple abscesses and fistulas¹³. In addition, because of the lack of effective circulation in a necrotic pulp or abscess, the effectiveness of oral antibiotics as a sole treatment for an odontogenic infection is highly arguable¹⁶. Konde *et al.*²⁵ reported that of practitioners who prescribed antibiotics, 34% did so to postpone appointments, 68% required special treatment and 35% at the coercion of parents. The study underlines that dentists are not worried about reducing this serious problem, although they are aware of antibiotic resistance. Another study from Kuwait emphasized that antibiotic abuse may be due to the heavy workload and personal comfort of dentists in the country¹⁵. The fact that non-clinical antibiotic use in our study data was less than other studies can be explained by the increased awareness of dentists and patients about antibiotic resistance.

We need to consider this study's results in light of some limitations. The study's cross-sectional nature limits its ability to make causal inferences. The dentists who chose to respond to the survey serving as representatives of all paediatric dentists in Turkey is another limitation. The respondents may also have been informed about the use of antibiotics. Moreover, the dentists' survey answers may not fully reflect their actual practice; given this limitation, the dentists' compliance with antibiotic use guidelines may be worse than actually reported.

Conclusions

This study's results provide preliminary data on the extent to which Turkish dentists follow professional guidelines for prescribing antibiotics for paediatric dental infections. This study shows a low adherence among all dentists to follow these guidelines. Clearer, more specific guidelines and increased post-graduate education can, however, reduce the negative consequences of over-prescribed antibiotics.

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