

Orthodontic Diagnosis, Treatment and Consultation Approaches of General Dental Practitioners: A Cross-Sectional Study

Genel Diş Hekimlerinin Ortodontik Tanı, Tedavi ve Yönlendirme Yaklaşımları: Kesitsel Araştırma

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ABSTRACT Objective: The aim of this study is to evaluate the perceptions and behaviours of general dental practitioners towards orthodontic diagnosis and treatment, and to determine when dentists refer patients to orthodontists. **Material and Methods:** The data in this research consists of 22 survey questions created using the Google Forms program. The questionnaire was sent to the members registered in the Turkish Dental Association via e-mail. 326 general dental practitioners participated in the study on a voluntary basis. The questionnaire consists of questions including demographic information of the participants, criteria for performing orthodontic examination, diagnostic recording, rates and distribution of orthodontic treatment, referral of patients to an orthodontist, and expectations after orthodontic treatment. Number Cruncher Statistical System 2007 (Kaysville, Utah, USA) program was used for statistical analysis. Significance was evaluated at $p < 0.01$ and $p < 0.05$ levels. **Results:** Of the 326 dentists (176 men, 150 women), it was found that 21.8% did not perform orthodontic examination at the first examination, 75.7% did not receive registration for orthodontic diagnosis and 51% worked with an orthodontist, 32.7% performed orthodontic treatment and applied clear aligner treatment at most (77.3%), 95.06% referred patients to an orthodontist for orthodontic treatment. Referral is most often performed in patients with skeletal anomalies and anterior open bite or crossbite. Fixed orthodontic treatment, removable appliances and clear aligner procedures are most frequently applied to the referred patients. **Conclusion:** Half of the dentists examined in our study worked with orthodontists, but most of them did not use orthodontic diagnosis methods, but it was common to refer patients to an orthodontist; it was concluded that some dentists applied orthodontic treatment and preferred clear aligner treatment the most.

ÖZET Amaç: Bu çalışmanın amacı, genel diş hekimlerinin ortodontik tanı, tedaviye karşı algı ve davranışlarının değerlendirilmesi ve diş hekimlerinin hastaları hangi durumlarda ortodonti uzmanına yönlendirdiklerinin belirlenmesidir. **Gereç ve Yöntemler:** Bu çalışmada kullanılan 22 anket sorusundan oluşmaktadır. Anket, Türk Dişhekimliği Birliğine kayıtlı olan üyelerle e-posta yoluyla gönderilmiştir. Çalışmaya gönüllülük esasına dayalı olarak 326 adet serbest diş hekimisi katılmıştır. Anket katılımcıların demografik bilgileri, ortodontik muayene yapma ve diagnostik kayıt alma kriterleri, ortodontik tedavi uygulama oranları ve uygulanan ortodontik tedavilerin dağılımları, ortodontik tedavi için hastaları ortodonti uzmanına yönlendirmesi ve ortodontik tedavi sonrası beklentilerini içeren sorulardan oluşmaktadır. İstatistiksel analiz için Number Cruncher Statistical System 2007 (Kaysville, Utah, ABD) programı kullanılmıştır. Anlamlılık $p < 0,01$ ve $p < 0,05$ seviyelerinde değerlendirildi. **Bulgular:** Üç yüz yirmi altı diş hekiminden (176 erkek, 150 kadın) %21,8'inin ilk muayenede ortodontik muayene yapmadığı, %75,7'sinin ortodontik tanı için kayıt almadığı ve %51'inin ortodonti uzmanı ile beraber çalıştığı, ortodontik teşhis yöntemlerini kullanan hekimlerin sıklıkla (%72,9) sefalometrik analizleri tercih ettikleri, diş hekimlerinin %32,7'sinin ortodontik tedavi uyguladıkları ve en fazla uygulanan tedavi yöntemlerinin (%77,3) şeffaf plak tedavisi olduğu, %95,06'sının ortodontik tedavi için hastaları ortodonti uzmanına yönlendirdikleri bulunmuştur. Yönlendirme en sık iskeletsel anomalisi ve ön açık kapanış veya çapraz kapanış bulunan hastalarda yapılmaktadır. Yönlendirilen hastalara en sık sabit ortodontik tedavi, hareketli aaparey ve şeffaf plak işlemleri uygulanmaktadır. **Sonuç:** Çalışmamızda incelenen diş hekimlerinin yarısının ortodontistle beraber çalıştığı, fakat çoğunun ortodontik tanı yöntemlerinden yararlanmadığı, ancak hastaları ortodonti uzmanına yönlendirmenin yaygın olduğu; bazı hekimlerin ortodontik tedavi uyguladıkları ve en çok şeffaf plak tedavisi tercih ettikleri sonucuna ulaşılmıştır.

Keywords: Orthodontic diagnosis; orthodontic treatment; general dental practitioners

Anahtar Kelimeler: Ortodontik tanı; ortodontik tedavi; genel diş hekimliği

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Early diagnosis and proper guidance of orthodontic cases is important for providing the best treatment to patients. Referrals to orthodontic specialists are usually from paediatric specialists and general dental practitioners (GDPs). GDPs are advised to be aware of the current treatment options and the correct time period of treatments, and it is essential that these practitioners are well informed about the correct diagnosis of early malocclusion problems.¹ GDPs mostly decide when and where to refer the patient.² If the patient is referred without being ready for treatment, it may cause unnecessary appointments. In addition, if a referral is made after the ideal time, the treatment may be more complex. A study conducted in the UK has found that one of the reasons that the waiting list for a new orthodontic patient consultation was excessively long that patients were referred unnecessarily by GDPs.³

Parfitt and Rock that surveyed 30 GDPs for treatment plan accuracy and referral model, the GDPs reported that only 14% of treatment plans were with the gold standard. In the study conducted in West Sussex, 52% of GDPs were able to accurately determine which patients should be referred to an orthodontist, while only 20% were able to determine the appropriate time of orthodontic referral.^{4,5} In addition, Berk et al. in studies by orthodontists, GDPs and paediatric dentist treatment, and compared the scores of all three groups about the need for orthodontic treatment needs assessment has shown a high level of alignment.⁶

Aldrees et al. in the study, which aimed to evaluate the orthodontic diagnosis skills, referral models and orthodontic benefit perceptions of paediatric and GDPs in comparison with orthodontists.⁷ As a result of the study, it was seen that 62.20% of orthodontists preferred permanent dentition to apply orthodontic treatment, while paediatricians preferred primary and early mixed dentition. Only 38.8% of paediatric dentists and 7.1% of GDPs applied orthodontic treatment clinically, that the treated malocclusions were often intended to correct crossbite, habit-breaking, minor tooth malocclusion, and that practitioners frequently used Hawley appliance and maxillary expansion. It was observed that they applied the appliance. In addition, most of the participants (58.1%) reported that

they referred 1-4 patients to an orthodontist per month, 19.4% referred 5-10 patients, 9.7% referred more than 10 patients, and 12.9% did not refer any patient to an orthodontist.

In a study in which general and paediatric dentists investigated subjective judgments regarding orthodontic case complexity and determined how case complexity perceptions affect their decision to refer the patient to an orthodontist, GDPs applied more fixed and clear aligner treatments than paediatric dentists, evaluated case complexity similarly, and it has been observed that pediatric dentists refer more patients to orthodontists than general dentists.⁸

The literature reports that 20% to 50% of all orthodontic treatments are performed by GDPs who do not have orthodontic specialty certificates.^{9,10} In a study of 10,607 GDPs in the United States, McGann reported that two-thirds of those surveyed had practiced some form of orthodontic treatment. McGann has found that GDPs who provide orthodontic services are busier and paid better.¹¹ Another study found that 76.3% of GDPs practice basic orthodontic treatment and 19.3% practice comprehensive orthodontic treatment.⁹ A critical assessment of the literature reveals that most of the studies on the evaluation of orthodontic treatment results address aspects related to the treatment performed by specialists and graduate students. Such studies focus specifically on the variables that contribute to the success or failure of treatment.^{12,13} Moreover, there are very few studies in the literature on orthodontic treatments offered by GDPs.¹⁴

The need for orthodontic treatment is mainly influenced by referrals from GDPs, paediatric dentists, or orthodontists, rather than just the fact that there is an application by the patient. Given the possible differences in the educational process, the perception of the need for orthodontic treatment may differ depending on the group of GDPs or orthodontic specialists. Although the gold standard for evaluating the need for orthodontic treatment is to be evaluated by an orthodontist, it is important to understand the perceptions of GDPs. Because they can directly and indirectly affect the provision and success of orthodontic treatment.

This study aimed to evaluate the orthodontic diagnosis and treatment approaches of GDPs, to examine the structure and frequency of orthodontic treatments applied, and to determine the approaches of referral to an orthodontist.

MATERIAL AND METHODS

This project has been reviewed and approved by the Ethical Committee of İstanbul Aydın University, (date: November 15, 2021, no: 2021/535) and conducted in accordance with the Principles of the Helsinki Declaration. Informed consent was obtained from the GDPs who agreed to take part in the study.

DESCRIPTION OF THE QUESTIONNAIRE

Our study was carried out with a 22-question questionnaire by contacting 326 GDPs, members registered with the Turkish Dental Association, by e-mail. The survey questions were created using the Google Forms (Google Inc., California, U.S.). Demographic information of the survey participants, orthodontic examination to register and diagnostic criteria, application rates and distributions of orthodontic treatments applied for orthodontic treatment, orthodontic treatment of the patient for orthodontic professional orientation, and after orthodontic treatment consists of a problem with expectations.

The GDPs participating in the study were evaluated in 4 main groups. These groups are formed as follows:

- Gender (male/female) and Age (under 35 years/35-45 years/over 45 years)
- The institution being worked (Private practice/Polyclinic, State/Foundation university, State hospital affiliated to the Ministry of health, Private Hospital, Other)
- Working with an orthodontist in the institution (Yes/No)

A questionnaire was created by the researcher in order to determine the main orthodontic problems of the patients, the diagnosis, treatment, referral approaches of dentists working in private practice or polyclinic, state/foundation university, state hospital affiliated to the Ministry of Health or private hospital, and the attitudes and expectations of dentists after

orthodontic treatment. While preparing this questionnaire, previous studies were used.^{15,16}

The questionnaire consisted of a total of 22 questions. The first 5 questions in the questionnaire included demographic data indicating the gender, age of the GDPs, the region where they work, their professional experience, and the type of institution where they work. The remaining 17 questions were the rate of orthodontic examination at the first visit, the rate and distribution of orthodontic diagnostic records, for orthodontic diagnosis the method of evaluation of the rate of utilization, distribution and classification of malocclusion rate factor rate research malocclusion, orthodontic treatment and rehabilitation for the purpose of their application in the protective and preventive rate distribution rate distributions for the application of orthodontic treatments applied orthodontic treatment, mild skeletal and/or dental malocclusion of prosthetic and/or treated with restorative methods, the rate of treatment application rate and distribution of the brands of transparent plates are applied, orthodontic specialist in orthodontics for the treatment of patients forwarding rate, the distribution of the situations referred to and the distribution of the procedures applied to the patients after the referral, the distribution of GDPs expectations after orthodontic treatment were covered.

STATISTICAL ANALYSIS

For statistical analysis, the Number Cruncher Statistical System 2007 (Kaysville, Utah, USA) program was used. While evaluating the study data, descriptive statistical methods (mean, standard deviation, median, frequency, ratio, minimum, maximum) as well as in order to determine the relationship between qualitative data, chi-square analysis were used. Significance was evaluated at $p < 0.01$ and $p < 0.05$ levels. Power analysis was performed for the sample size.

RESULTS

326 GDPs participated in the study, and the distribution of GDPs according to gender, age, professional experience, and place of work is shown in (Table 1).

Of the GDPs, 53.8% (n=175) were female and 46.2% (n=150) were male. It was determined that

59.7% of the GDPs worked at the age distribution of under 35 years, and 12.3% over 45 years, 68.3% on the European side and 8% out of İstanbul. GDPs, 40.9% of the period of 0-6-year-old spent years in dentistry, when 24.6% of the years between 6-10% to 13.8% between 10-15 years, 10% between the years of 15-20% and 9.8% were over 20 years. It was determined that 75.1% of GDPs work in a private practice, 6.2% in a private hospital, 5.5% in a public hospital, and 1.8% in other types of institutions.

The distribution of the GDPs, the presence of an orthodontist in the institution, the rate of conducting an orthodontic examination during the first examination, receiving diagnostic records for orthodontic diagnosis, and the records taken is shown in (Table 2).

It was determined that 46.5% of GDPs work together with an orthodontist, and 22.5% never perform an orthodontic examination at the first visit. In their initial consultation, making an orthodontic examination with the status of gender, work, institution, was found a statistically significant difference between the presence orthodontic specialist in the institution, while there was a statistically significant relationship between age ($p<0.01$) (Table 2). It was found that only 22.5% ($n=73$) of GDPs received a diagnostic record for orthodontic diagnosis and orthodontic photography was used most often.

The ratio of GDPs referring patients to an orthodontist and the distribution of procedures applied to patients after situations and referrals are shown in (Table 3).

95.1% of GDPs ($n=309$) refer patients to an orthodontist for orthodontic treatment. In terms of referral of patients, a statistically significant relationship was found between the type of institution and the presence of an orthodontist in the institution ($p<0.001$) (Table 3). Orientation is most often performed in patients with skeletal anomalies and anterior open bite or cross bite. Fixed orthodontic treatment, removable appliances and clear aligner procedures are most often applied to the referred patients.

The rate of orthodontic treatment by GDPs to their patients, the distribution of orthodontic treatments applied, the rate of treatment of mild skeletal

TABLE 1: Demographic data of the study group.

		n	%
Gender	Woman	175	53.8
	Man	150	46.2
Age	Under 35	194	59.7
	35-45	91	28.0
	Over 45 years old	40	12.3
Place	Asian part of İstanbul	77	23.7
	European part of İstanbul	222	68.3
	Out of İstanbul	26	8.0
Year	0-6 years	133	40.9
	6-10 years	80	24.6
	10-15 years	45	13.8
	15-20 years	35	10.8
	20 years and over	32	9.8

TABLE 2: Percentage of GDPs taking orthodontic records and working with orthodontists.

		n	%
Orthodontic examination at the first visit	Always	73	22.5
	Sometimes	179	55.0
	Never	73	22.5
Obtaining a diagnostic record for diagnosis	Yes	73	22.5
	No	252	77.5
Received diagnostic records	Orthodontic photography	50	68.5
	Cast model	45	61.6
	Lateral cephalometric radiographs	47	64.4
	Panoramic radiographs	39	53.4
	Hand-wrist radiography	14	19.2
Working with orthodontist	Yes	151	46.5
	No	174	53.5

GDP: General dental practitioner.

and/or dental malocclusions with prosthetic and/or restorative methods is shown in (Table 4).

It was determined that 27.7% ($n=90$) of the GDPs applied orthodontic treatment and the most common treatment was clear aligner application. It was found that 8% ($n=26$) of the applied clear aligner brand was Invisalign (Align Technology, San Jose, California, U.S.), 5.8% ($n=19$) was Orthero (Şeffaf Aparey San. Tic. A.Ş., İstanbul, Türkiye), and 1.5% ($n=5$) was Clear Correct (Straumann Group, Basel, Switzerland). While no difference was found between the orthodontic treatment application of GDPs and gender, a statistically significant difference was found

TABLE 3: The rate of referral of the patients to the orthodontist and the conditions of referral and the distribution of the procedures applied to the patients after the referral.

		n	%
Referral to an orthodontist	Yes	309	95.1
	No	16	4.9
Cases	Dental anomalies	130	42.1
	Skeletal anomalies	295	95.5
	Malocclusions	202	65.4
	Delayed eruption/Impacted teeth		
	Anterior open bite/Cross bite	119	38.5
	Early tooth loss		
	TMJ discomfort	217	70.2
	Crowding	66	21.4
	Diastema	60	19.4
	Other	174	56.3
		121	39.2
Applications to patients	Removable appliances	188	60.8
	Functional appliances	103	33.3
	Fixed orthodontic treatment		
	Clear aligner	288	93.2
	Impacted teeth	164	53.1
	TMJ splint	42	13.6
	Eruption guidance	54	17.5
	Placeholder	27	8.7
	Orthognathic surgery	61	19.7
	Cleft lip and palate	36	11.7
	Other	24	7.8
	2	0.6	

TMJ: Temporomandibular joint.

between age and type of institution ($p < 0.05$). 65.22% of GDPs treat malocclusions via prosthetic/restorative methods and mostly investigate the cause of malocclusion. The ratio and distribution of GDPs using preventive and preventive treatment methods for the purpose of orthodontic rehabilitation and the expectations of GDPs after orthodontic treatment are shown in (Table 4).

60% of GDPs practice preventive treatment. The most common preventive treatments in the clinic are periodic check-ups, fissure sealant and placeholders. A significant relationship was found between the gender, the type of institution where the task was performed and the presence of an orthodontist in the institution for the procedures they perform in clinics ($p < 0.05$) (Table 5). GDPs expect to eliminate the pa-

tient's aesthetic anxiety, provide occlusal Class I closure and eliminate the crowding after treatment.

DISCUSSION

This research was conducted in order to determine the orthodontic diagnosis, treatment and orientation approaches of GDPs. There have been very few studies evaluating the referral process for orthodontic treatment and the factors affecting this process, and no current study on this issue has been conducted in Türkiye.

Over the past 20 years, significant changes have occurred in the practice of orthodontics. It is assumed that one of the most important reasons behind the observed changes in practice trends is the increase in the number of non-orthodontists providing orthodon-

TABLE 4: The Orthodontic treatment application rate, distribution of applied orthodontic treatments, treatment rate of malocclusions with prosthetic and/or restorative methods, investigation of the cause of malocclusion, distribution of GDPs using preventive and preventive treatment methods for the purpose of orthodontic rehabilitation, and distribution of expectations after orthodontic treatment.

		n	%
Orthodontic treatment application	Yes	90	27.7
	No	235	72.3
Applied treatments	Removable appliances	32	35.6
	Functional appliances	26	28.9
	Fixed orthodontic treatment	31	34.4
	Clear aligners	68	75.6
	TMJ splint	24	26.7
	Other	5	5.6
Prosthetic and/or restorative treatment	Yes	212	65.2
	No	113	34.8
Causes of malocclusion research	Yes	103	80.5
	No	25	19.5
Preventive treatment	Yes	195	53.8
	No	130	46.2
Methods of preventive treatment	Periodic control	168	86.2
	Placeholder	86	44.1
	Fissure sealant	99	50.8
	Application of florid	51	26.2
	Habit braker appliances	36	18.5
	Eruption guidance	44	22.6
	Other	2	1.0
Expectation after orthodontic treatment	Relieving the patient's aesthetic anxiety	286	88.0
	Ensuring Class I closure of the occlusal relationship	243	74.8
	Clearing crowds	190	58.5
	Contributing to oral hygiene	137	42.2
	Correcting speech function	141	43.4
	Relief of TMJ discomfort	91	28.0
	Preparing the patient for prosthetic treatment	107	32.9

TMJ: Temporomandibular joint.

tic services.⁹ Orthodontic treatment is a specialty that requires postgraduate education and must be performed by orthodontic specialists. However, orthodontic treatments provided by GDPs have been reported in the literature, even if the results were contradictory.^{4,9} In a survey of orthodontic practices, Gottlieb reported a slowdown in orthodontics in the late 1970s and early 1980s.¹⁷ Gottlieb suggested that this decrease was partly due to an increase in the number of both orthodontist and non-orthodontist dentists providing orthodontic services, as well as a decrease in the birth rate and a changing economy associated with rising inflation rates.¹⁷ Moore also pointed out

that the number of GDPs providing orthodontic services has increased. It seemed that significant percentage of GDPs provide some kind of orthodontic service.¹⁸

Hilgers et al. found that pediatric dentists spend less than 10% of their time providing orthodontic treatment, and Galbreath et al. similarly, noted that GDPs spend less than 10% of their time providing orthodontic treatment.^{19,20} It has been shown that a large percentage of pediatric and GDPs provide comprehensive orthodontic treatment (62% and 17.9%, respectively).²¹ Another study found that 76.3% of GDPs provided basic orthodontic treatment and

TABLE 5: Comparison of distributions according to gender, age, type of institution and working status with orthodontist.

		Preventive treatment			
		Yes	No		p value
Gender	Woman	114a (65.1%)	61b (34.9%)		0.041*
	Man	81a (54%)	69b (46%)		
Age	Under 35	115 (59.3%)	79 (40.7%)		0.578
	35-45	53 (58.2%)	38 (41.8%)		
	Over 45 years old	27 (67.5%)	13 (32.5%)		
Type of institution served in dentistry	Private practice	161a (66%)	83b (34%)		0.001**
	Private hospital	11a (55%)	9a (45%)		
	Public hospital	4a (22.2%)	14b (77.8%)		
	State/Foundation university hospital	17a (45.9%)	20a (54.1%)		
	Other	2a (33.3%)	4a (66.7%)		
Working with orthodontist	Yes	81a (53.6%)	70b (46.4%)		0.029*
	No	114a (65.5%)	60b (34.5%)		
		Orthodontic examination at the first visit			p value
		Always	Sometimes	Never	
Gender	Woman	34 (19.4%)	97 (55.4%)	44 (25.1%)	0.250
	Man	39 (26%)	82 (54.7%)	29 (19.3%)	
Age	Under 35	30a (15.5%)	110b (56.7%)	54b (27.8%)	0.001**
	35-45	29a (31.9%)	47a, b (51.6%)	15b (16.5%)	
	Over 45 years old	14a (35%)	22a, b (55%)	4b (10%)	
Type of institution served in dentistry	Private practice	56a (23%)	140a (57.4%)	48a (19.7%)	0.295
	Private hospital	3a (15%)	11a (55%)	6a (30%)	
	Public hospital	2a (11.1%)	11a (61.1%)	5a (27.8%)	
	State/Foundation university hospital	10a (27%)	16a (43.2%)	11a (29.7%)	
	Other	2a (33.3%)	1a (16.7%)	3a (50%)	
Working with orthodontist	Yes	40a (26.5%)	83a (55%)	28a (18.5%)	0.138
	No	33a (19%)	96a (55.2%)	45a (25.9%)	
		Orthodontic treatment application			p value
		Yes	No		
Gender	Woman	45 (25.7%)	130 (74.3%)		0.389
	Man	45 (30%)	105 (70%)		
Age	Under 35	39a (20.1%)	155b (79.9%)		0.001**
	35-45	32a (35.2%)	59a (64.8%)		
	Over 45 years old	19a (47.5%)	21b (52.5%)		
Type of institution served in dentistry	Private practice	77a (31.6%)	167b (68.4%)		0.038*
	Private hospital	5a (25%)	15a (75%)		
	Public hospital	3a (16.7%)	15a (83.3%)		
	State/Foundation university hospital	3a (8.1%)	34b (91.9%)		
	Other	2a (33.3%)	4a (66.7%)		
Working with orthodontist	Yes	40 (26.5%)	111 (73.5%)		0.652
	No	50 (28.7%)	124 (71.3%)		
		Referral to an orthodontist			p value
		Yes	No		
Gender	Woman	165 (94.3%)	10 (5.7%)		0.476
	Man	144 (96%)	6 (4%)		
Age	Under 35	182 (93.8%)	12 (6.2%)		0.432
	35-45	88 (96.7%)	3 (3.3%)		
	Over 45 years old	39 (97.5%)	1 (2.5%)		
Type of institution served in dentistry	Private practice	231a (94.7%)	13a (5.3%)		0.009**
	Private hospital	20a (100%)	0a (0%)		
	Public hospital	17a (94.4%)	1a (5.6%)		
	State/Foundation university hospital	37a (100%)	0a (0%)		
	Other	4a (66.7%)	2b (33.3%)		
Working with orthodontist	Yes	150a (99.3%)	1b (0.7%)		0.001 **
	No	159a (91.4%)	15b (8.6%)		

a and b: Each letter indicates the differences between the columns. While there is no difference between similar letters, there is a difference between different letters.
Chi-Square Texts **p<0.01 * p<0.05

19.3% provided comprehensive orthodontic treatment.⁹ GDPs with a high-volume orthodontic service profile were found to treat more difficult cases, and there was a predicted increase in the amount of orthodontic treatment administered in general practice.⁵ In our study, it was found that 27.7% of GDPs applied orthodontic treatment, which was similar to a recent previous study.²² Orthodontic treatment is a treatment that requires expertise and has complications such as root resorption and gingival recession if not applied correctly. If patients with severe crowding are treated without extraction, significant arch expansion and proclination of the teeth will be required beyond what is generally considered stable and periodontally healthy. When extraction is preferred, understanding the correct moment-force ratios needed during treatment will be critical for its stability and success, as the teeth tend to tip over into the extraction cavities, the bite deepens as the gap is closed, and anchorage control is critical. With additional specialist training, orthodontists are aware of how to cope with the biomechanical challenges of such clinical situations, and may be more aware of misalignments in alignment, as well as more comfortable using appliances such as clear aligners to move teeth.²³

According to result of this study, GDPs who were providing orthodontic treatment mostly applied clear aligner therapy (75.6%). Orthodontics is a specialty and must be performed by orthodontic specialists. Although dentists can get some certificates by participating in the clear aligner certification programs, it should not be ignored that additional mechanics are needed in such cases where there are limitations such as providing root parallelism in clear aligner treatments. One study reported that orthodontists were more frequently adding aids such as precise cuts for elastics and lingual attachments for teeth that did not follow planning. Overall, orthodontists spend more time reviewing the clear aligner planning software and are more likely to make improvements. Furthermore, orthodontists have different goals for the patients they treat than general dentists, who do not report much change in the planning software and examine patients in more detail for the ideal treatment. It should not be forgotten that or-

thodontic treatment is not only performed to meet aesthetic expectations, but it is also associated with many conditions such as temporomandibular joint (TMJ), muscle functions, and periodontal health, and there are serious complications as a result of incorrect treatments. According the results of our study, the population of GDPs using clear aligners is increasing, GDPs should consider applying orthodontic treatments more consciously, and that orthodontic treatment is a specialty, even if clear aligners are used.²³

Aldrees et al. showed that 58.1% of GDPs referred their patients to orthodontists.⁷ Moreover, GDPs stated that they mostly refer complex cases and growing patients to orthodontists. Similarly, in our study, 95.1% (n=309) of GDPs referred patients to an orthodontist, mostly (95.5%) of skeletal anomalies, and there was statistical significance between working with an orthodontist and the type of institution, it was determined that dentists working with orthodontists in the institution made more referrals. It is seen that almost half of the GDPs in our study work with an orthodontist. This situation is associated with the increase in the number of orthodontic specialists and the development in multidisciplinary work from past to present. Aldrees et al. stated that the best way to improve GDPs' patient referral relationships was to improve inter-office communication (45%). In our study, the finding that GDPs working with orthodontists made more referrals may be related to the increase in communication between offices, which also supports the result of the previous studies.⁷

Orthodontic anomalies can be of skeletal or dental origin, or they can be seen as a combination of both. Crowding in their teeth is the top reason for patients applying to orthodontic clinics to seek treatment.^{24,25} The best way to treat orthodontic anomalies is possible by knowing the morphological structures of these anomalies and making the correct diagnosis accordingly. For this reason, the diagnostic records to be taken are of great importance for the correct diagnosis and treatment to be applied. It has been determined that only 22.5% of the GDPs participating in our study performed orthodontic examination at the first examination, and it was determined that mostly GDPs under the age of 35 performed or-

thodontic examination at the first examination, and young general dentists were more interested in orthodontics.

It was determined that 77.5% of the GDPs participating in the study did not receive a diagnostic record for orthodontic diagnosis. Furthermore, it was found that orthodontic photograph was the most obtained diagnostic record with 68.5%. The reason why this method is preferred might be that it is easy to use, it can evaluate the whole mouth at the same time, and it is easy to repeat.

One of the best diagnostic tools in orthodontics is radiography. The purpose of cephalometric analysis is to identify the area of the facial skeleton that is at fault, which is responsible for the occurrence of orthodontic anomalies. Because the best orthodontic treatment is the type of treatment performed by intervening in the area where the morphological structure disorder is located.^{22,26} Accordingly, the fact that only half of the GDPs who reported that they received a diagnostic record in this study had a lateral cephalometric radiograph indicates that GDPs are insufficient in using orthodontic diagnostic methods. These findings show that GDPs who perform orthodontic treatment may not detect skeletal anomalies correctly and it is possible to plan a treatment by ignoring skeletal problems.

It was determined that 80.5% of the GDPs who used the evaluation methods made malocclusion factor research, and 19.5% did not (Table 4). It provides important information in terms of determining which type of malocclusion the patients applying to orthodontic clinics have, determining the needs of the relevant clinics and providing better service to the patients.²⁷ Although the Angle classification used in the evaluation of malocclusions is a limited classification method since it does not include vertical and transversal anomalies, it is a classification method that is reproducible and has been universally accepted and is not affected by the personal perspective of the researchers.²⁸ There are also some studies on the dental classification of the patient population who apply to orthodontic clinics in Türkiye for treatment or receive treatment.²⁹ Gelgör et al. showed that the majority of the adolescent population in Türkiye has Angle Class

2 Division 1 anomaly.²⁹ We think that GDPs should benefit more from orthodontic diagnosis and diagnosis methods for the early diagnosis and correct guidance of such skeletal anomalies. Furthermore, it was shown that most of the GDPs (68%) were not satisfied with their orthodontic training, but 42% provided orthodontic treatment and orthodontic treatment service increased by 61% in the last 5 years.³⁰ In this study, it is seen that 65.22% of GDPs treat malocclusions with prosthetic/restorative methods. Orthodontic treatment should be provided primarily in the correction of malocclusions and prosthetic/restorative methods should be applied when necessary. In order to provide more successful treatments to patients and to encourage appropriate referrals, the referral practitioner community should be trained and the dialogue between GDPs and orthodontists should be increased, and the orthodontic curriculum in the undergraduate education process should be improved.

The TMJ is a building block in the dynamics of interaction between masticatory muscles and occlusion, which must adapt to dentition function. Arnett et al. stated that an unstable occlusion may cause changes in the condyle and surrounding tissues.³¹ With orthodontic treatments, changes in the existing occlusion order can be achieved and it is stated that joint dysfunctions and positions of the jaws are regulated.³² Lee et al. found that GDPs (77%) did not agree with the opinion that orthodontic treatment is preventive of TMJ disease.³³ Similarly, in our study, it was found that only 28% of the GDPs expected the TMJ problem to be resolved after orthodontic treatment. Orthodontics is one of the main treatment methods for TMJ problems and GDPs should be informed more about this issue and awareness should be raised about appropriate referrals to specialist for patients with TMJ problems.³¹

GDPs who have not received clinical training in orthodontics are expected to act within the framework of preventive and interceptive treatments. According to this study, 60% of the GDPs applied preventive treatment and frequently made periodic controls. This is followed by fissure sealant application with a rate of 50.8%. Recent clinical studies report that pit and

fissure sealants are an effective caries prevention measure. In a report evaluating evidence-based clinical studies and reviews on fissure sealants published by the American Dental Association in 2008, it was stated that fissure sealants should be applied to the primary and/or permanent teeth of children, young adults and adults in the high caries risk group, and that enamel material should not be removed in fissures that do not show cavitation.³⁴ Preventive treatments are mostly applied by GDPs working in private practice in this study. This result might be related to the fact that preventive treatment practices depend on the socio-economic status of the families.

Park et al. evaluated trends in the public's choice of practitioners for orthodontic treatment over the past 15 years and specifically questioned their opinions between orthodontists and GDPs.³⁵ As a result of the research, participants' knowledge of orthodontists was limited; 85% believe that GDPs who perform orthodontic treatment are also orthodontists. Moreover, 89.7% were unaware that a dentist cannot be called an orthodontist without further training from an accredited residency program. Finally, 64.2% of respondents did not know that an orthodontist should receive more training than a GDPs. It is thought that one of the reasons why 1/3 of GDPs provide orthodontic treatment and prefer clear aligners the most, as seen in current study, might be due to the insufficient knowledge of the patients about orthodontists. In order to prevent possible treatment complications, patients need to be more aware of orthodontists and their training.

CONCLUSION

Half of the GDPs examined in this cross-sectional study work with orthodontists, but most of them do

not use orthodontic diagnostic methods, but it is common to refer patients to an orthodontist in cases of skeletal anomalies. It has been determined that GDPs, who have not received clinical training in orthodontics, apply orthodontic treatment and mostly prefer clear aligner treatment to mostly eliminate aesthetic concerns. GDPs should be enlightened that orthodontics is a real specialty and that complex orthodontic treatments, including clear aligners, should be performed by an orthodontist/specialist in order to prevent possible complications.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Emre Kayalar; **Design:** Emre Kayalar; **Control/Supervision:** Emre Kayalar; **Data Collection and/or Processing:** Emre Kayalar, Pelin Erdoğan, Rafet Güneş; **Analysis and/or Interpretation:** Emre Kayalar, Pelin Erdoğan, Rafet Güneş; **Literature Review:** Emre Kayalar, Pelin Erdoğan, Rafet Güneş; **Writing the Article:** Emre Kayalar, Pelin Erdoğan; **Critical Review:** Emre Kayalar, Pelin Erdoğan; **References and Fundings:** Emre Kayalar, Pelin Erdoğan; **Materials:** Emre Kayalar, Pelin Erdoğan.

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