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Orthodontic treatment and referral patterns: A survey of pediatric dentists, general practitioners, and orthodontists



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KEYWORDS

Orthodontist;
Pediatric dentist;
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Perception;
Knowledge

Abstract *Objective:* This study aims to assess the orthodontic diagnostic skills, referral patterns, and the perceptions of orthodontic benefits of pediatric and general dentists in comparison with orthodontists.

Materials and methods: Two online surveys were e-mailed to pediatric dentists, general dentistry practitioners, and orthodontists registered as members of the Saudi Dental Society and the Saudi Orthodontic Society. The surveys included questions about the type of orthodontic treatment provided, referral trends, and timing; presumed benefits associated with successful orthodontic treatment; and diagnosis and treatment plans of seven cases representing different malocclusions.

Results: In total, 25 orthodontists, 18 pediatric dentists, and 14 general practitioners completed the survey. Only 38.8% of pediatric dentists and 7.1% of general practitioners reported that they practiced orthodontics clinically. The perceptions of the three groups toward the benefits of orthodontic treatment were comparable in the psychosocial areas. However, the orthodontists perceived significantly lesser effects of orthodontic treatment on the amelioration of temporomandibular disorder (TMD) symptoms. Pediatric dentists tended to rate the need and urgency of treatment higher, while general practitioners tended to rate the need of treatment lower. The selected treatment plans for three early malocclusion cases showed the greatest discrepancies between the orthodontists and the other two groups.

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Conclusions: The orthodontists consistently and significantly downplayed the perceived benefit of orthodontic treatment to reduce TMD symptoms. Also, while there was a similarity in the diagnosis, there were notable differences in the proposed treatment approaches, perceived treatment need, and timing of intervention between the three groups of practitioners.

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1. Introduction

The early diagnosis and referral of orthodontic cases is important for providing the best care to patients. Referrals to orthodontic clinics usually occur from pediatric and general practices. Although these practitioners are advised to be aware of the treatment options available and the most efficient timing of their application (Ngan and Fields, 1995), it is essential that pediatric and general dentists are well informed about the correct diagnosis of early malocclusion problems.

Orthodontic treatment provided by pediatric and general dentists has been reported in the literature, but the results are conflicting. While Hilgers et al. found that pediatric dentists spent less than 10% of their time providing orthodontic treatment (Hilgers et al., 2003) and Galbreath et al. similarly noted that general dentists spent less than 10% of their time providing orthodontic treatment (Galbreath et al., 2006), a study by Koroluk et al. showed that a large percentage of pediatric and general dentistry practitioners provided comprehensive orthodontic treatment (62% and 17.9%, respectively) (Koroluk et al., 1988). In another study, 76.3% of general practitioners were found to provide basic orthodontic treatment and 19.3% provided comprehensive orthodontic treatment (Wolsky and McNamara, 1996). General practitioners who showed a profile of high-volume orthodontic services were found to treat more difficult cases and there was a projected increase in the amount of orthodontic treatment performed in general practice (Jacobs et al., 1991). Thus, the anticipated increase or decrease in orthodontic treatment in pediatric or general practice is debatable and has been discussed in most of the previously mentioned articles.

General dentistry practitioners usually decide whether, when, and where to refer the patient. They are considered to be gatekeepers for specialist dental care (de Bondt et al., 2010). If referrals are made before the patient is ready for treatment, this may result in unnecessary appointments. However, if referrals are made after the 'ideal' time, the treatment may be more complex and lengthy. A study in England revealed that one reason for an excessive length in the waiting list of new orthodontic patient consultation is the unnecessary referral of patients by general practitioners (O'Brien et al., 1996). In a study by Parfitt and Rock who surveyed 30 general practitioners for their treatment plan accuracy and referral pattern, only 14% of general practitioner treatment plans agreed with the gold standard (Parfitt and Rock, 1996). In West Sussex, while 52% of dentists were able to correctly identify which type of orthodontic provider they refer to, only 20% of them were able to determine the appropriate time of orthodontic referral (Jackson et al., 2009). According to Berk et al. when the treatment need assessment scores of orthodontists, general dental practitioners, and pediatric dentists are compared, it was found that all three groups exhibited high levels

of agreement on orthodontic treatment needs (Berk et al., 2002).

Dental students in the USA were surveyed to determine their ability to recognize malocclusions and measure their diagnostic skills. The study concluded that four years of undergraduate education did not improve the students' orthodontic diagnostic skills (Brightman et al., 1999). Among the British dental schools that were studied, 75% did not expect their new graduates to be able to formulate an orthodontic treatment plan. They also believed that undergraduate training should be concentrated more on the diagnosis and recognition of a dental malocclusion, rather than on the formulation of a treatment plan (Rock et al., 2002).

A survey of orthodontists suggested that early orthodontic intervention is the norm among practitioners in the United States, but practice characteristics affected treatment timing (Yang and Kiyak, 1998). Another survey showed that the majority of orthodontists recommended that the first assessment of an occlusion should be carried out before the age of 7 and that cross bites should be preferably applied during primary- and early-mixed dentition stages (Pietila et al., 2008).

This study aims to assess the diagnostic skills, referral patterns, and treatment approach provided by pediatric and general dentists in regard to orthodontic care. Comparison with orthodontists in terms of unity of diagnosis and treatment options, as well as treatment timing, was done to provide a baseline. Varying knowledge of the benefits associated with orthodontic treatment was also evaluated.

2. Materials and methods

This study utilized two self-administered online surveys: the first was directed toward pediatric and general dentists and the second was directed toward orthodontists (Tables 1 and 2). The study was registered and ethical approval was granted by the College of Dentistry Research Center, King Saud University (#IR 0043). The surveys started with biographic data (age, specialty, where and when the dental degree was earned) and then, to assess the respondents' opinions and knowledge, continued with general questions about the types of orthodontic treatment provided, referral amount and timing, and presumed risks and benefits associated with successful orthodontic treatment. This was followed by the presentation of seven cases, each of which included five intraoral photographs, a panoramic radiograph, and cephalometric tracing (Figs. 1 and 2). The participants were asked to diagnose the malocclusion that was being presented and to choose the most effective treatment option, in their opinion, for each case. The appropriate timing of treatment was also asked, as well as the level of treatment need. The second survey (that was directed toward the orthodontists) consisted of the same questions as the previously mentioned survey. The same cases were

Table 1 The pediatric dentists and general practitioners survey.

1.	Gender:	<input type="checkbox"/> Male			<input type="checkbox"/> Female	
2.	Age:				
3.	What is your specialty?	<input type="checkbox"/> Pediatric Dentistry		<input type="checkbox"/> AEGD		<input type="checkbox"/> Other, ...
	Where did you study your postgraduate program?	<input type="checkbox"/> Saudi Arabia	<input type="checkbox"/> Middle East	<input type="checkbox"/> Asia	<input type="checkbox"/> Europe	<input type="checkbox"/> North America
	Graduation Year:				
4.	Where did you study your undergraduate program?	<input type="checkbox"/> Saudi Arabia	<input type="checkbox"/> Middle East	<input type="checkbox"/> Asia	<input type="checkbox"/> Europe	<input type="checkbox"/> North America
	Graduation Year:				
5.	Where do you practice?	<input type="checkbox"/> Academic Institution	<input type="checkbox"/> Government: Hospital or Dental Center	<input type="checkbox"/> Government: Primary Dental Care Clinic	<input type="checkbox"/> Full-time Private Practice	<input type="checkbox"/> Part-time Private Practice
6.	Do you have a Clinical Certificate in Orthodontics?	<input type="checkbox"/> No			<input type="checkbox"/> Yes, please specify ...	
7.	Where did you receive most of your orthodontic knowledge?	<input type="checkbox"/> CE Courses (1-2 day courses)	<input type="checkbox"/> Postgraduate Training Programs	<input type="checkbox"/> Undergraduate Dental Education		<input type="checkbox"/> Other
8.	Do you practice orthodontics?	<input type="checkbox"/> No			<input type="checkbox"/> Yes	
	Average number of cases treated orthodontically every year?				
	What percentage of your office time do you spend providing orthodontic treatment?	<input type="checkbox"/> 0	<input type="checkbox"/> 1-10%	<input type="checkbox"/> 11-25%	<input type="checkbox"/> 26-50%	<input type="checkbox"/> 51-75% <input type="checkbox"/> 76-100%
	Which of the following stages of dental development do you treat orthodontically?	<input type="checkbox"/> None	<input type="checkbox"/> Primary Dentition	<input type="checkbox"/> Early Mixed Dentition	<input type="checkbox"/> Late Mixed Dentition	<input type="checkbox"/> Permanent Dentition
	What type of orthodontic treatment do you provide?	<input type="checkbox"/> None Provided	<input type="checkbox"/> Minor Tooth Malpositions Tx	<input type="checkbox"/> Crossbite Tx	<input type="checkbox"/> Serial Extraction Procedures	<input type="checkbox"/> Class I Malocclusions Tx
	What sort of appliances do you use?	<input type="checkbox"/> Class II and/or Class III Malocclusion Tx	<input type="checkbox"/> Deep-bite/Open-bite Tx	<input type="checkbox"/> Habits Management	<input type="checkbox"/> Removable Hawley with auxiliary springs	<input type="checkbox"/> Other, please specify ...
		<input type="checkbox"/> None Used	<input type="checkbox"/> Sectional Fixed Appliances (2x4, etc.)	<input type="checkbox"/> Full Fixed Appliances	<input type="checkbox"/> Palatal Expansion	<input type="checkbox"/> Other, please specify ...
		<input type="checkbox"/> Clear Aligners (e.g. Invisalign)	<input type="checkbox"/> Functional Appliances	<input type="checkbox"/> Headgear (Cervical, Facemask, etc.)		<input type="checkbox"/> > 10 patients
9.	How many patients do you refer to the orthodontist every month (on average)?	<input type="checkbox"/> None	<input type="checkbox"/> 1-4 patients		<input type="checkbox"/> 5-10 patients	
10.	Please, rate the adequacy of the orthodontic education you received during your undergraduate dental years? Poor _____ Excellent					
11.	If applicable-Please, rate the adequacy of the orthodontic training you received during your postgraduate education? Poor _____ Excellent					
12.	In each of the following questions, Please read each question carefully and slide the circle on the horizontal line to mark your answer: Great Improvement _____ No Improvement					
	- Do you think that successfully completed orthodontic treatment will reduce the Risk of Caries?					
	- Do you think that successfully completed orthodontic treatment will Improve Self-Esteem?					
	- Do you think that successfully completed orthodontic treatment will Reduce TMD Problems?					
	- Do you think that successfully completed orthodontic treatment will Improve Physical Attractiveness?					
	- Do you think that successfully completed orthodontic treatment will Reduce Periodontal Disease?					
	- Do you think that successfully completed orthodontic treatment will make the Teeth Easier to Clean?					
	- Do you think that successfully completed orthodontic treatment will Reduce Teasing Incidents?					
13.	In each of the following 7 cases:					
	1. What are the main problems of the malocclusion?					
	a. <input type="checkbox"/> Class I	<input type="checkbox"/> Class II division 1	<input type="checkbox"/> Class II division 2	<input type="checkbox"/> Class III		
	b. <input type="checkbox"/> Average Overbite	<input type="checkbox"/> Deep Overbite	<input type="checkbox"/> Shallow OB (edge to edge)	<input type="checkbox"/> Open Bite		
	c. <input type="checkbox"/> Normal Transverse	<input type="checkbox"/> Unilateral Crossbite	<input type="checkbox"/> Bilateral Crossbite	<input type="checkbox"/> Anterior Crossbite		
	d. <input type="checkbox"/> Normal Alignment	<input type="checkbox"/> Crowding	<input type="checkbox"/> Spacing			
	2. In your opinion, to what extent does this occlusion need orthodontic treatment?					
	<input type="checkbox"/> None	<input type="checkbox"/> Minimal Need	<input type="checkbox"/> Moderate Need	<input type="checkbox"/> Great Need	<input type="checkbox"/> Extremely Great Need	
	3. If Applicable-When should orthodontic treatment start?					
	<input type="checkbox"/> Immediately	<input type="checkbox"/> After 2-3 years	<input type="checkbox"/> Other, when patient is ...			
	4. What would be your orthodontic treatment plan?					
	<input type="checkbox"/> Functional Appliances	<input type="checkbox"/> Rapid Palatal Expansion	<input type="checkbox"/> Orthognathic Surgery	<input type="checkbox"/> Protraction Headgear (Reverse Pull)	<input type="checkbox"/> Comprehensive Fixed Appliances Tx	
	<input type="checkbox"/> Extraction of 2 Upper Premolars	<input type="checkbox"/> Headgear (Cervical, High-Pull)	<input type="checkbox"/> Sectional Fixed Appliances (2x4)	<input type="checkbox"/> Extraction of Upper and Lower Premolars	<input type="checkbox"/> Other, ...	

Table 2 The orthodontists' survey.

1.	Gender	<input type="checkbox"/> Male		<input type="checkbox"/> Female		
2.	Age:				
3.	Where did you qualify in Orthodontics from?	<input type="checkbox"/> Saudi Arabia	<input type="checkbox"/> Middle East	<input type="checkbox"/> Asia	<input type="checkbox"/> Europe	<input type="checkbox"/> North America
4.	Graduation Year: Where did you study your undergraduate program? <input type="checkbox"/> Saudi Arabia	<input type="checkbox"/> Middle East	<input type="checkbox"/> Asia	<input type="checkbox"/> Europe	<input type="checkbox"/> North America
5.	Graduation Year: Where do you practice? <input type="checkbox"/> Academic Institution	<input type="checkbox"/> Government: Hospital or Dental Center	<input type="checkbox"/> Government: Primary Dental Care Clinic	<input type="checkbox"/> Full-time Private Practice	<input type="checkbox"/> Part-time Private Practice
6.	Regarding the referrals you receive, please rate the frequency by percentage:	...% from Pediatric Dentists	...% from General Practitioners		...% from Others	
7.	Which of the following stages of dental development do you treat orthodontically?	<input type="checkbox"/> None	<input type="checkbox"/> Primary Dentition	<input type="checkbox"/> Early Mixed Dentition	<input type="checkbox"/> Late Mixed Dentition	<input type="checkbox"/> Permanent Dentition
8.	What sort of appliances do you use?	<input type="checkbox"/> None Used <input type="checkbox"/> Clear Aligners (e.g. Invisalign)	<input type="checkbox"/> Sectional Fixed Appliances (2×4, etc.) <input type="checkbox"/> Functional Appliances	<input type="checkbox"/> Full Fixed Appliances <input type="checkbox"/> Headgear (Cervical, Facemask, etc.) <input type="checkbox"/> 15-18	<input type="checkbox"/> Removable Hawley with auxiliary springs <input type="checkbox"/> Other, please specify ...	<input type="checkbox"/> Palatal Expansion
9.	Ages of the patients mostly referred to your office?	<input type="checkbox"/> 7-10	<input type="checkbox"/> 11-14		<input type="checkbox"/> > 18	
10.	In each of the following questions, Please read each question carefully and slide the circle on the horizontal line to mark your answer: Great Improvement _____ No Improvement					
	- Do you think that successfully completed orthodontic treatment will reduce the Risk of Caries?					
	- Do you think that successfully completed orthodontic treatment will Improve Self-Esteem?					
	- Do you think that successfully completed orthodontic treatment will Reduce TMD Problems?					
	- Do you think that successfully completed orthodontic treatment will Improve Physical Attractiveness?					
	- Do you think that successfully completed orthodontic treatment will Reduce Periodontal Disease?					
	- Do you think that successfully completed orthodontic treatment will make the Teeth Easier to Clean?					
	- Do you think that successfully completed orthodontic treatment will Reduce Teasing Incidents?					
11.	In each of the following 7 cases:					
	1. What are the main problems of the malocclusion?					
	a. <input type="checkbox"/> Class I	<input type="checkbox"/> Class II division 1	<input type="checkbox"/> Class II division 2	<input type="checkbox"/> Class III		
	b. <input type="checkbox"/> Average Overbite	<input type="checkbox"/> Deep Overbite	<input type="checkbox"/> Shallow OB (edge to edge)	<input type="checkbox"/> Open Bite		
	c. <input type="checkbox"/> Normal Transverse	<input type="checkbox"/> Unilateral Crossbite	<input type="checkbox"/> Bilateral Crossbite	<input type="checkbox"/> Anterior Crossbite		
	d. <input type="checkbox"/> Normal Alignment	<input type="checkbox"/> Crowding	<input type="checkbox"/> Spacing			
	2. In your opinion, to what extent does this occlusion need orthodontic treatment?					
	<input type="checkbox"/> None	<input type="checkbox"/> Minimal Need	<input type="checkbox"/> Moderate Need	<input type="checkbox"/> Great Need	<input type="checkbox"/> Extremely Great Need	
	3. If Applicable-When should orthodontic treatment start?					
	<input type="checkbox"/> Immediately	<input type="checkbox"/> After 2-3 years	<input type="checkbox"/> Other, when patient is ...			
	4. What would be your orthodontic treatment plan?					
	<input type="checkbox"/> Functional Appliances	<input type="checkbox"/> Rapid Palatal Expansion	<input type="checkbox"/> Orthognathic Surgery	<input type="checkbox"/> Protraction Headgear (Reverse Pull)	<input type="checkbox"/> Comprehensive Fixed Appliances Tx	<input type="checkbox"/> Other, ...
	<input type="checkbox"/> Extraction of 2 Upper Premolars	<input type="checkbox"/> Headgear (Cervical, High-Pull)	<input type="checkbox"/> Sectional Fixed Appliances (2×4)	<input type="checkbox"/> Extraction of Upper & Lower Premolars		

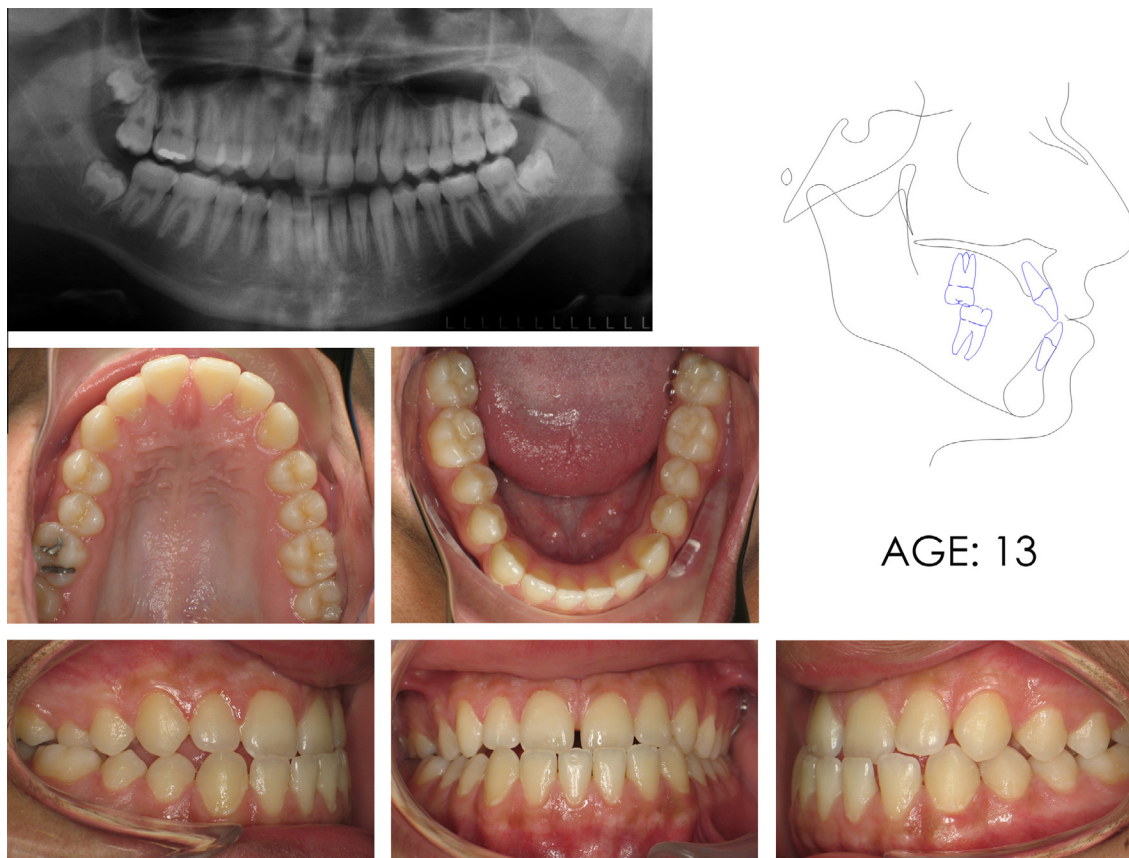


Figure 1 Case #1 (Class III, age 13) full records as presented in the survey.

presented to serve a baseline for comparison with the results of the pediatric dentists' and general practitioners' answers.

A pilot study was performed before uploading the surveys online, in order to assess the appropriateness and clarity of the questions and the cases. The pilot study sample included participants representing the three intended groups (three pediatric dentists, three general practitioners, and four orthodontists) and each received a hard copy of the survey. Few

changes in regard to the biographic data questions were made. The ages of the patients were added, as well as more treatment options to select from.

The surveys were then uploaded to the website <http://www.surveymoz.com> and the links to the surveys were sent to the participants. The email addresses of the participants were obtained from the Saudi Dental Society database as well as investigators' contact lists.

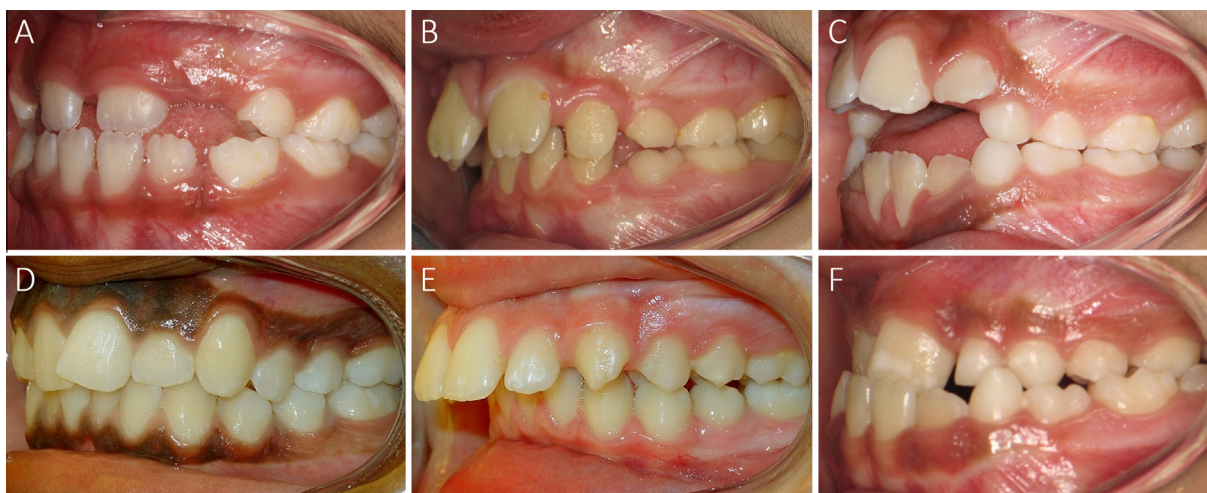


Figure 2 Left buccal intraoral photographs of the remaining 6 cases shown in the survey: (A) Class I, crowding, age 8, (B) Class II div 1, age 8, (C) Class I, open bite, age 8, (D) Class I, crowding, age 13, (E) Class II div 1, age 12, (F) Class III, age 8.

Table 3 Frequency of referral sources and dental stages of the patients treated as reported by the orthodontists.

	Mean	SD	p-Value
<i>Source of referral</i>			
Pediatric dentists	26.52	21.624	0.008
GP's	45.92 [†]	25.173	
Others	27.56	24.707	
<i>Dental stage of treated patients</i>			
Permanent dentition	62.20 [‡]	21.119	< 0.0001
Late mixed dentition	24.68 ^{**}	15.148	
Early mixed dentition	10.76	6.648	
Primary dentition	2.36	3.094	

Tukey's *post hoc* test:

* Significantly higher than other 2 types of referrals.

** Significantly higher than early mixed dentition and primary dentition but significantly lower than permanent dentition.

‡ Significantly higher than other 3 stages.

3. Results

The links to surveys were sent to 70 pediatric dentists, 100 general dentist practitioners, and 60 orthodontists. Invitation emails were sent starting December 22, 2013 and the surveys were closed on March 16, 2014 with four email reminders sent in between.

3.1. Orthodontist survey

Twenty-five surveys were completed by the invited orthodontists. The mean age of the participants was 40.6 years old (± 8.06 years), 68% of them were male, and 32% were female. Their year of graduation ranged from 1983 to 2012, 48% graduated from Saudi-Arabian orthodontic programs, and 32% from North-American programs. Places of work varied between governmental hospitals, academic institutions, and full-time private practice, with 20% of the orthodontists reporting that they work part-time in a private practice in addition to their full time job.

The orthodontists generally found that referrals came mainly from general practitioners and the difference was statistically significant (Table 3). Nearly two thirds of the patients were treated in the permanent dentition stage (62.20%), which was significantly more than the other dental stages. The appliances mostly used by the orthodontists are shown in Fig. 3.

3.2. Pediatric dentist and general dentist survey

Eighteen pediatric dentists completed the surveys and their mean age was 37.33 years (± 9.1 years). Among the responding pediatric dentists, 55.6% were male while 44.4% were female. Their place of work varied between governmental hospitals, academic institutions, and full-time private practices, with 22.2% of them reporting that they work part-time in private practices. The responders noted that they had completed their specialty training programs between 1988 and 2013, 11.1% from European programs, 38.9% from Saudi-Arabian programs, and 50% from North-American programs. Only 11.1% of them have a clinical certificate in orthodontics, but 38.8% reported practicing orthodontics.

Fourteen general dentistry practitioners completed the surveys with a mean age of 30.9 years (± 7.9 years) and equally distributed between genders. Most of the responders worked at governmental hospitals (71.4%), and the rest served at academic institutions. Responders noted that they had graduated between 1970 and 2013, and that 92.86% of them had completed their dental programs in Saudi Arabia. Only one (7.1%) of the responding general practitioners reported practicing orthodontics.

As opposed to the orthodontists, the most common dental stages treated orthodontically by the pediatric dentists are the primary and the early-mixed dentitions, followed by late-mixed and then permanent dentition stages.

The services provided included treatment for (in decreasing order): cross bite, habit management, minor tooth malposition, serial extraction, deep-bite, open-bite, and Class I, Class II, and Class III malocclusion treatment. The devices used are shown in Fig. 3. It was also found that most of the participants (58.1%) referred 1–4 patients to the orthodontist per month, 19.4% referred 5–10 patients, 9.7% more than 10 patients, and 12.9% reported not referring any patients to the orthodontist.

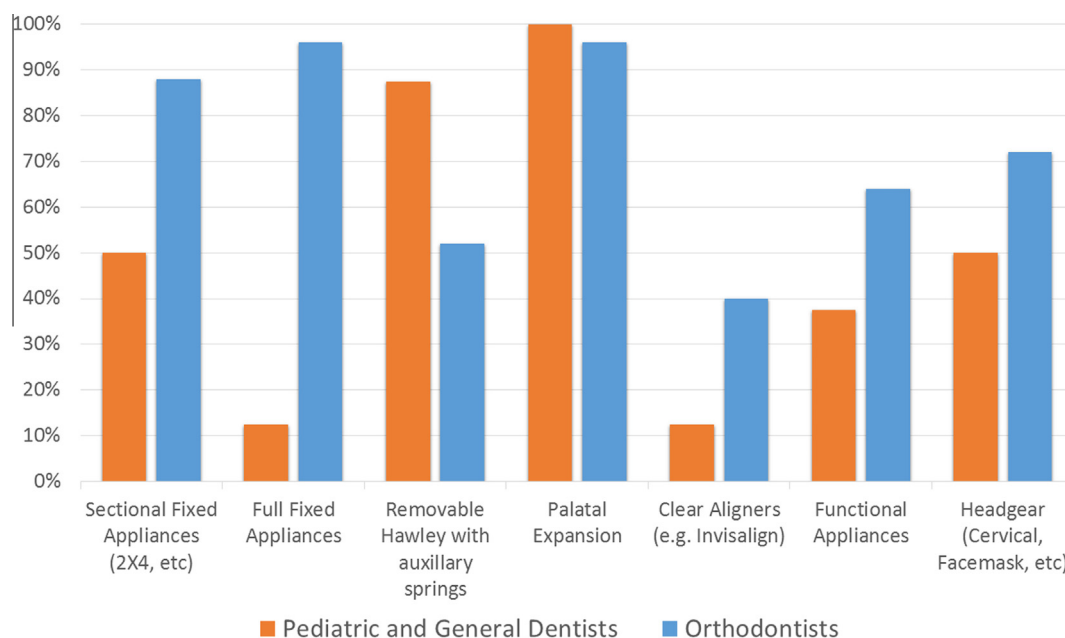


Figure 3 Distribution of the orthodontic appliances mostly used by the pediatric dentists and general practitioners, and the orthodontist.

Table 4 Comparison of the perception scores of the three groups toward the risks and benefits of orthodontic treatment (ranging between 100 “Great effect” and 0 “No effect”).

Perceptions	Group	Mean	SD	p-Value
Reduce the risk of caries	Orthodontists	43.80	32.219	0.12
	Pediatric dentists	61.94	39.375	
	GP's	65.71	36.630	
Improve self-esteem	Orthodontists	89.80	21.040	0.13
	Pediatric dentists	81.39	32.935	
	GP's	69.29	38.474	
Reduce TMD problems	Orthodontists	27.20	26.848	0.01*
	Pediatric dentists	58.44	38.859	
	GP's	48.50	34.290	
Improve physical attractiveness	Orthodontists	83.44	23.417	0.98
	Pediatric dentists	84.72	25.125	
	GP's	83.07	18.403	
Reduce periodontal disease	Orthodontists	58.92	29.006	0.67
	Pediatric dentists	54.61	41.476	
	GP's	65.79	37.250	
Make the teeth easier to clean	Orthodontists	73.76	25.218	0.64
	Pediatric dentists	81.22	34.739	
	GP's	80.79	25.974	
Reduce teasing incidents	Orthodontists	83.96	17.876	0.05
	Pediatric dentists	75.94	25.080	
	GP's	64.86	27.895	

* ANOVA shows a statistically significant difference between the three groups.

3.3. Comparison of the three practitioner groups

There was a significant difference between the groups in terms of the perceived effect that orthodontic treatment can have on reducing temporomandibular disorder (TMD) symptoms (Table 4). However, the perceptions were very close in terms of improving physical attractiveness, reducing periodontal disease, and making the teeth easier to clean. The orthodontists also saw a greater positive effect of successful orthodontic treatment on reducing teasing incidents and improving self-esteem, and lesser effects on reducing TMD problems and risk of caries.

In most of the cases, there was great agreement among the three groups in terms of the diagnosis of each of the seven cases on the questionnaire. In the sagittal dimension, there was good agreement, with an exception of three cases (Class I, Class II division 1) that were thought to be Class II division 2 by few pediatric dentists (17–28%). In the vertical and transverse dimensions, no major diversities were observed.

In general, pediatric dentists tended to rate the need of treatment higher, while the general practitioners tended to rate the need of treatment lower than the other two groups (Table 5). Pediatric dentists also tended to rate the urgency of treatment higher than the other two groups.

The proposed treatment plans for three of the early malocclusion cases showed the greatest discrepancies between the three groups. In the case of an 8-year-old child with Class I and an open bite, about 37% of the orthodontists recommended headgear and comprehensive fixed-appliances treatment, while 42% of the pediatric dentists and 47% of the general practitioners would have recommended the use of functional appliances. In the case of an 8-year-old child with Class I and crowding, the same approach was selected by the pediatric dentists and the general practitioners (27% and 43%, respectively), while only 3% of the orthodontists recommended functional appliances. In the early Class II malocclusions case (Fig. 4), two-thirds of the orthodontists recommended a rapid palatal expander and facemask, while 44% and 30% of the pediatric dentists and general practitioners, respectively, selected only a facemask for treatment.

4. Discussion

This study aimed to assess the orthodontic diagnostic and treatment-planning skills of pediatric dentists and general practitioners. It revealed that there was generally an agreement between the three groups, in terms of giving an accurate diagnosis. In the sagittal dimension, there was a good agreement, with an exception of three cases that were thought to be Class II division 2 by few pediatric dentists instead of Class I/Class II division 1. This agreement coincides with the study by Berk et al. that found a high level of agreement between pediatric dentists, general practitioners, and orthodontists (Berk et al., 2002). The confusion between Class II division 1 and 2 might indicate a need for further clarification of the definitions of the two types of Class II malocclusions, through interdisciplinary continuing education courses. Some treatment plans, on the other hand, show great discrepancies between the three groups. The use of functional appliances was recommended by the pediatric dentists and the general practitioners far more than the orthodontists in early-malocclusion cases (Class I, crowding, open bite), while the use of a facemask was not selected by a large percentage of the pediatric dentists and the general practitioners in the early Class-III malocclusion case. These results suggest that the three groups agree on the diagnosis of the malocclusion, but the approach to proper orthodontic treatment seems to be unclear for the pediatric dentists and the general practitioners.

Most orthodontic treatments were provided by the orthodontists during the permanent dentition stage, while the general and pediatric dentists provided treatment primarily during the primary and early-mixed dentition stages (in equal amounts), which decreased as the patients grew. This was in agreement with the study by Hilgers et al. for the pediatric

Table 5 Distribution of the responses of the 3 groups to the treatment need and timing questions of the 7 cases (by percentage).

Cases	Case 1 (Class III, age 13)			Case 2 (Class I, crowding, age 8)			Case 3 (Class II div 1, age 8)			Case 4 (Class II, open bite, age 8)			Case 5 (Class I, crowding, age 13)			Case 6 (Class II div 1, age 12)			Case 7 (Class III, age 8)			
	Moderate	Great	Extremely great	Moderate	Great	Extremely great	Moderate	Great	Extremely great	Moderate	Great	Extremely great	Moderate	Great	Extremely great	Moderate	Great	Extremely great	Moderate	Great	Extremely great	
Orthodontists	16	64	20	16	40	44	8	44	48	12	36	52	88	8	4	36	64	36	36	36	64	
Pediatric dent.	11	61.4	27.8	33.4	22.2	44.4	11.1	27.8	61.1	5.6	33.3	61.1	83.3	11.1	5.6	38.9	61.1	5.6	11.1	11.1	83.3	
GP's	50	35.7	14.3	50	42.9	7.1	14.1	50	35.7	7.1	28.6	64.3	92.9	7.1	—	42.9	28.6	—	35.7	64.3	64.3	
Appropriate time to start orthodontic Tx	—	After 2-3 years	Other	Immediately	After 2-3 years	Other	Immediately	After 2-3 years	Other	Immediately	After 2-3 years	Other	Immediately	After 2-3 years	Other	Immediately	After 2-3 years	Other	Immediately	After 2-3 years	Other	After 2-3 years
Orthodontists	68	—	32	80	12	8	56	28	16	83.3	12.5	4.2	68	32	—	96	4	92	—	—	8	
Pediatric dent.	88.9	11.1	—	70.6	29.4	—	82.4	17.6	—	94.1	—	5.9	72.2	22.2	5.6	76.5	17.6	88.9	11.1	—	—	
GP's	78.6	7.1	14.3	23.1	69.2	7.7	42.9	42.9	14.3	78.6	7.1	14.3	64.3	21.4	14.3	85.7	7.1	76.9	15.4	7.7	7.7	

dentists and in disagreement with the study by Galbreath et al. for the general practitioners (Galbreath et al., 2006; Hilgers et al., 2003). About one-third of the pediatric dentists and less than 10% of the general practitioners were found to provide orthodontic treatment in this study. In contrast, the study by Koroluk et al. showed that 62% of pediatric dentists and 17.9% of general practitioners provide comprehensive orthodontic treatment (Koroluk et al., 1988). Wolsky and McNamara also showed a large percent (76.3%) of general practitioners who provide orthodontic treatment to their patients (Wolsky and McNamara, 1996). In terms of practice time dedicated to orthodontic treatment, Hilgers et al. and Galbreath et al. showed that most of the pediatric dentists (59.4%) and general practitioners (88.3%) spent less than 10% of their time providing orthodontic treatment (Galbreath et al., 2006; Hilgers et al., 2003). Discrepancies in the percentages of orthodontic clinical experience between the practitioners in Saudi Arabia and the United States may be related to the differences in the provision of dental health care (government-owned vs. private practice). The malocclusions (cross bites, habit management, minor tooth malocclusion) mostly treated by the pediatric dentists and general practitioners in the current study were found to be similar to those reported by Hilgers et al. and Galbreath et al. Also, the appliances mostly used (palatal expansion, removable Hawley appliances) were similar to the findings of Hilgers et al. and Galbreath et al. (Galbreath et al., 2006; Hilgers et al., 2003).

In regard to the perceived benefits of orthodontic treatment, the psychosocial variables (improved self-esteem, improved physical attractiveness, and reduced incidents of teasing) received the highest ratings by the three groups with no significant differences between them. Dental health factors were rated lower than the psychosocial variables with a significant difference between the groups in terms of the perceived benefit of orthodontic treatment to ameliorate TMD symptoms. Orthodontists tended more often than the other groups to appreciate the psychosocial benefits of orthodontic treatment, but rated the effect on TMD symptoms significantly lower. These results were similar to the Hunt et al. study, which showed that general dental practitioners rated an improvement in physical attractiveness as the most important benefit of orthodontic treatment (Hunt et al., 2001). Both groups also rated the reduction of TMD problems as the smallest benefit of orthodontic treatment (Hunt et al., 2001). Studies have not reliably confirmed the presence of positive effects of orthodontic treatment on periodontal health or the reduction in the incidence of dental caries (Bollen et al., 2008; Helm and Petersen, 1989). Also, comprehensive reviews concluded that, based on currently available evidence, orthodontists should avoid claiming that orthodontic treatment has the potential to influence TMD (Burden, 2007). Psychologically, orthodontic treatment can enhance some aspects of oral health-related quality of life, however, self-esteem does not appear to be significantly affected (Kiyak, 2008). The results of the present study indicate that pediatric dentists, general practitioners, and (to some extent) orthodontists tend to have unrealistic expectations of the dental health benefits of orthodontic treatment. The evidence-based approach to the continuing dental education courses should be implemented to address these perceptions.

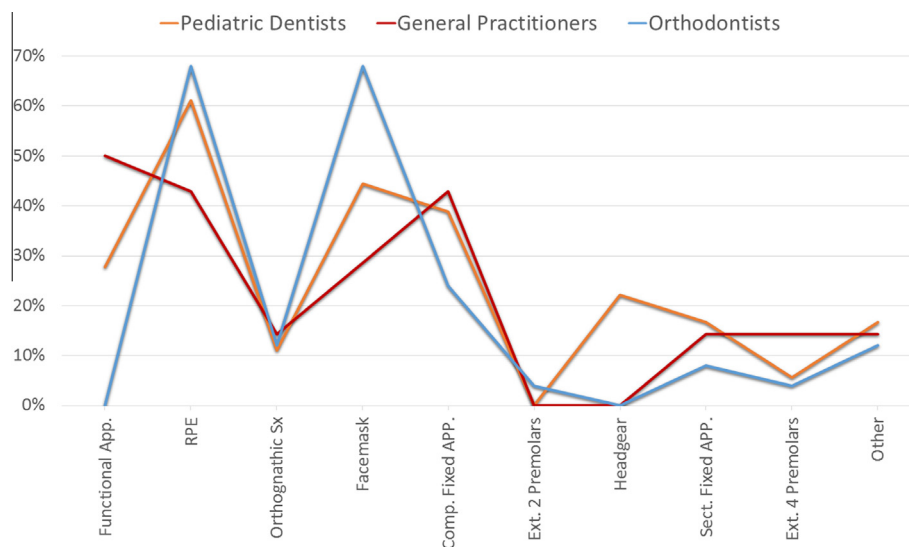


Figure 4 Treatment options as suggested by the participants in the 3 groups for Case #7 (Class III, age 8) by percentage of the participants selecting the plan.

Pediatric dentists were found to rate the need for treatment higher, while general practitioners tended to rate the need for treatment lower than the other two groups. Pediatric dentists were also found to rate the urgency of treatment higher than the two groups. This may be related to the fact that pediatric dentists are usually the first dental health care professionals to clinically examine the children and they are more oriented toward addressing malocclusal complications as soon as they are observed. These results did not agree with the findings by Berk et al. which showed a high level of agreement between pediatric and general practitioners (Berk et al., 2002). Differences in the educational experiences and the practice settings between the practitioners in the USA and Saudi Arabia may explain the differences in the perceived need and timing of treatment.

This study was limited by the difficulties we encountered in obtaining a higher response rate. Despite several reminder emails sent by the professional society, as well as personal messages sent by the investigators over the course of 3 months, the response was insufficient to provide a representative sample. There were a large number of participants who partially filled the survey and were excluded from the statistics. This might have been due to the length of the survey and the attached seven cases. The current study should be regarded as a pilot for further comprehensive studies that look into the interdisciplinary agreement in diagnosis and treatment recommendations. The results of such studies can impact the undergraduate/postgraduate curricula and influence the professional continuing education programs.

5. Conclusions

Based on the findings of this pilot study, the following can be concluded:

- (1) The perceptions of pediatric dentists, general dentistry practitioners, and orthodontists were not statistically different regarding the benefits of successfully completed

orthodontic treatment; however, the orthodontists rated the effect of “reducing TMD problems” significantly less than the other groups.

- (2) There was agreement among the three groups in regard to the accurate diagnosis of orthodontic cases; however, the selected treatment plans differ in a number of the early malocclusion cases.
- (3) Pediatric dentists tended to rate the need and urgency for treatment higher, while the general practitioners tended to rate the need for treatment lower than the other two groups.

Conflict of interest

The authors have no conflict of interest to declare.

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References

- Berk, N.W., Bush, H.D., Cavalier, J., Kapur, R., Studen-Pavlovich, D., Sciote, J., Weyant, R.J., 2002. Perception of orthodontic treatment need: opinion comparisons of orthodontists, pediatric dentists, and general practitioners. *J. Orthod.* 29, 287–291 (discussion 277).
- Bollen, A.M., Cunha-Cruz, J., Bakko, D.W., Huang, G.J., Hujoel, P.P., 2008. The effects of orthodontic therapy on periodontal health: a systematic review of controlled evidence. *J. Am. Dent. Assoc.* 139, 413–422.
- Brightman, B.B., Hans, M.G., Wolf, G.R., Bernard, H., 1999. Recognition of malocclusion: an education outcomes assessment. *Am. J. Orthod. Dentofacial Orthop.* 116, 444–451.

- Burden, D.J., 2007. Oral health-related benefits of orthodontic treatment. *Semin. Orthod.* 13, 76–80.
- de Bondt, B., Aartman, I.H., Zentner, A., 2010. Referral patterns of Dutch general dental practitioners to orthodontic specialists. *Eur. J. Orthod.* 32, 548–554.
- Galbreath, R.N., Hilgers, K.K., Silveira, A.M., Scheetz, J.P., 2006. Orthodontic treatment provided by general dentists who have achieved master's level in the Academy of General Dentistry. *Am. J. Orthod. Dentofacial Orthop.* 129, 678–686.
- Helm, S., Petersen, P.E., 1989. Causal relation between malocclusion and caries. *Acta Odontol. Scand.* 47, 217–221.
- Hilgers, K.K., Redford-Badwal, D., Reisine, S., 2003. Orthodontic treatment provided by pediatric dentists. *Am. J. Orthod. Dentofacial Orthop.* 124, 551–560.
- Hunt, O., Hepper, P., Johnston, C., Stevenson, M., Burden, D., 2001. Professional perceptions of the benefits of orthodontic treatment. *Eur. J. Orthod.* 23, 315–323.
- Jacobs, R.M., Bishara, S.E., Jakobsen, J.R., 1991. Profiling providers of orthodontic services in general dental practice. *Am. J. Orthod. Dentofacial Orthop.* 99, 269–275.
- Kiyak, H.A., 2008. Does orthodontic treatment affect patients' quality of life? *J. Dent. Educ.* 72, 886–894.
- Koroluk, L.D., Jones, J.E., Avery, D.R., 1988. Analysis of orthodontic treatment by pediatric dentists and general practitioners in Indiana. *ASDC J. Dent. Child.* 55, 97–101.
- Ngan, P., Fields, H., 1995. Orthodontic diagnosis and treatment planning in the primary dentition. *ASDC J. Dent. Child.* 62, 25–33.
- O'Brien, K., McComb, J.L., Fox, N., Bearn, D., Wright, J., 1996. Do dentists refer orthodontic patients inappropriately? *Br. Dent. J.* 181, 132–136.
- Parfitt, A.A., Rock, W.P., 1996. Orthodontic treatment planning by general dental practitioners. *Br. J. Orthod.* 23, 359–365.
- Pietila, I., Pietila, T., Pirttiniemi, P., Varrelä, J., Alanen, P., 2008. Orthodontists' views on indications for and timing of orthodontic treatment in Finnish public oral health care. *Eur. J. Orthod.* 30, 46–51.
- Rock, W.P., O'Brien, K.D., Stephens, C.D., 2002. Orthodontic teaching practice and undergraduate knowledge in British dental schools. *Br. Dent. J.* 192, 347–351.
- Wolsky, S.L., McNamara Jr., J.A., 1996. Orthodontic services provided by general dentists. *Am. J. Orthod. Dentofacial Orthop.* 110, 211–217.
- Yang, E.Y., Kiyak, H.A., 1998. Orthodontic treatment timing: a survey of orthodontists. *Am. J. Orthod. Dentofacial Orthop.* 113, 96–103.