

Orthodontists' Preferences and Selection Criteria for Functional Appliances

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ABSTRACT

Introduction: Dentofacial orthopedic functional appliances are widely used by orthodontists for growth modification treatment in growing patients with skeletal discrepancies.

Aim: To investigate the preferences and selection criteria of functional appliances by orthodontists practicing in Saudi Arabia.

Materials and methods: This is a cross-sectional study in which an electronic survey was emailed to all members of the Saudi Orthodontic Society. The survey consisted of three parts including background information, preferences of functional appliances use, and factors affecting functional appliance selection. Descriptive analysis and inferential statistics were conducted using Chi-square or Fisher exact test with a significant level set at $p < 0.05$.

Results: 104 orthodontists participated in the study, majority were practicing in the private sector and represented the major three geographic areas of the country. Intra-oral removable appliances were the most preferred for management of skeletal Class II cases (64.4%) while extra-oral appliances were the most preferred for skeletal Class III (80.8%). Functional appliances were more frequently used (66.4%) than headgear (23.1%) on a routine basis. The topmost preferred functional appliance was the Twin Block (73%); followed by Forsus (56.7%); and Herbst (23%). Statistically significant association was present between the type of functional appliance preferred with years of experience ($p < 0.05$) and residency training ($p < 0.01$). Patient's compliance was the most considered factor in selecting the type of functional appliance.

Conclusion: Orthodontists revealed a predominant use of functional appliances over headgear. Similar to the European trend, the Twin Block was the most preferred appliance. Preference for the type of functional appliance was influenced by orthodontists' years of experience and location of their residency training.

Key words: Functional appliances, Headgear, Preferences, Selection criteria

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INTRODUCTION

Orthopedic functional appliances have been used by orthodontists over many decades for management of various jaw deformities involving deficient or excess growth of either the mandible or maxilla. In growing patients, functional appliances could guide and promote the growth of a deficient mandible or maxilla; moreover, they can hinder or slow down the growth of excessively growing mandible or maxilla. Functional appliances were introduced over a hundred years ago and ever since different

types were developed some of which faded and considered obsolete while others are still in use until now days, nevertheless with some improvements and modifications [1].

Functional appliances could be classified into removable and fixed types. Each type is characterized by specific features that attract orthodontists to use them in their practice. Removable appliances are cost-effective, hygienic and easy to clean, and highly acceptable by the patients. However, they are usually made of fragile acrylic material that make them susceptible for breakage and might not achieve the required results in case of compliance problems [1]. Fixed functional appliances recognized by their continuous delivery of force and compliance is less of an issue in comparison to removable appliances. Nevertheless, they

could interrupt oral hygienic measures, a little more expensive, and might cause tissue damage [2].

In 1990, as part of a national survey of members of the American Association of Orthodontists results indicated the numbers of orthodontists routinely using functional appliances has increased by 2.5 times comparing to a decade ago. Moreover, the Bionator was the appliance of preference for almost half of the orthodontists at that time [3]. Nevertheless, recent national US surveys showed that there was a remarkable increase in the routine use of Forsus and Herbst fixed appliances [4,5]. Members of the British Orthodontic Society revealed that the Twin Block was the preferred appliance of choice [6]. Similarly, members of the Australian Society of Orthodontists chose the Twin Block as the appliance of most preference [7].

In the light of the current literature, our study aims to investigate further details regarding functional appliances including types preferred and selection criteria by orthodontic offices in Saudi Arabia as to the best of our knowledge no previous studies were conducted in the area.

MATERIALS AND METHODS

Ethical approval

The study was conducted after the approval by Taibah University College of Dentistry-Research Ethics Committee (TUCD-REC) under the approval letter number TUCDREC/20190918/MBadri.

Study design and sample size

The current study was designed as an observational analytical cross-sectional study targeting orthodontists practicing in Saudi Arabia and registered with the Saudi Orthodontic Society (SOS). According to the last announced statistics the SOS reported an average of 400 specialists and consultants in orthodontics. A web-based sample size calculator (Rosasoft) was used in order to estimate the recommended sample size. Based on a margin error of 5%, confidence level of 95%, and a response distribution of 50% the recommended sample size was 197. An electronic survey was delivered through SOS to the emails of all registered members, and a second reminder email was sent 3 weeks later.

Data collection tool

Validated questionnaires from previous

studies [3,7,8] used as guidance for the current survey with some modifications. The current questionnaire consisted of three main parts, the first part consisted of 5 questions regarding demographics and background including: gender, years of experience, location of orthodontic residency, area of current practice and type of working sector. The second part included 9 close-ended questions reflecting functional appliances preferences of use. The third part included 7 Likert type-items regarding factors affecting functional appliances selection.

Statistical analysis

Results of completed responses were analyzed using the software (IBM SPSS Statistics, Version 23). Descriptive analysis was used in the form of frequencies and percentages to describe demographic data and answers for Likert type-items together with bar charts illustrations. Inferential statistics were conducted using Chi-square test or Fisher exact test if the expected frequency was less than 5 for more than 20% of the results, in order to demonstrate the association between types of functional appliances preferred and orthodontists' background. In addition, Cramer's V was used to measure the strength of the resulted association between those variables. Statistical significance levels were determined at 95% with p-value < 0.05 considered to be significant.

RESULTS

The final obtained sample size of orthodontists participated in the study was 104, thus increased our margin of error up to 8.28%. Demographics and background data (Table 1) showed that around two third of the participants were males. Majority of the orthodontists had a practicing experience of 15 years or less. Participants who had their residency training in Asia were mainly trained in southeast Asia and India. More than half of the Middle East trained orthodontists had joined training programs in Saudi Arabia (53.3%) while the rest had trained in North Africa and Mediterranean Sea countries. Most of North America trained orthodontists had joined programs in United States of America while few trained in Canada. The two training programs reported as "other" were located in Argentina and Australia. Distribution of orthodontists based on their current region of practice showed

Table 1: Demographic data of participating orthodontists (N=104).

		n (%)
Gender	Male	68 (65.4)
	Female	36 (34.6)
Years of experience	0-5	30 (28.8)
	6-10	31 (29.8)
	11-15	21 (20.2)
	>15	22 (21.2)
Location of orthodontic residency	Asia	22 (21.2)
	Europe	26 (25)
	Middle East	30 (28.8)
	North America	24 (23.1)
	Other	2 (1.9)
Location of current practice	Central	43 (41.3)
	Eastern	21 (20.2)
	Northern	4 (3.8)
	Southern	4 (3.8)
	Western	32 (30.8)
Working sector	Private practice	70 (67.3)
	Teaching Institution	35 (33.7)
	Governmental Hospital	22 (21.2)

that they were practicing in three main areas predominantly in central; followed by western; then eastern areas. The major bulk of the participants were working in the private sector.

Table 2 shows responses of orthodontists toward preferred types of functional appliances in comparison to headgears and specific cases they would consider using them for. In patients with Class II skeletal discrepancy, intra-oral removable appliances were the devices that reported highest selection for management of such cases; followed by intra-oral fixed appliances; and the least reported were extra-oral appliances. On the other hand, the preference for management of cases of Class III skeletal discrepancy was reversed. The majority of orthodontists selected extra-oral appliances as the devices of choice; followed by intra-oral fixed appliances; and intra-oral removable appliances.

Upon comparing the overall use of headgear against functional appliance for dentofacial orthopedic treatment, orthodontists revealed significantly predominate use of functional appliances with 66.4% using them on a regular basis while a big bulk reported to rarely-never use headgear as high as 76.9%. In addition, only 5.8% of orthodontists never used functional appliances compared to 20.2% never used headgear. Among the practitioners using functional appliances, 25% indicated to never use the fixed type; on the other hand, 13.5% never used the removal type of functional

appliances.

Responses of orthodontists showed that the most preferred functional appliance in the management of Class II cases was the Twin Block; the second most common was Forsus; followed by Herbst which was similar in rank to the combined use of Activators and Bionators; and among the least reported were MARA and Frankel II appliances.

The type of orthopedic device selected for the management of skeletal discrepancies changed based on the affected jaw. When Class II cases caused by maxillary prognathism the majority preferred to choose the headgear device; on the contrary, not a single orthodontist preferred to use it when the deformity was due to mandibular deficiency. In cases of Class III, when the discrepancy was due to deficient maxilla the Face mask was the predominant option; however, there seemed to be no agreement on the type of appliance preferred if the discrepancy involved excessive mandibular growth.

Table 3 presents the association between the type of functional appliance preferred and the demographic variables of the orthodontists. There was no statistically significant association between the type of appliance selected and gender, location of current practice, or type of working sector ($p>0.05$). Association with years of experience was statistically significant ($p<0.05$) and orthodontists with 10 years or

Table 2: Orthodontists responses toward functional appliances preferences questionnaire.

	(n)	%
1. Which type of growth modification appliances do you prefer to use in Class II Skeletal cases?		
Extra-oral appliances	22	21.2
Intra-oral removable appliances	67	64.4
Intra-oral fixed appliances	47	45.2
2. Which type of growth modification appliances do you prefer to use in Class III Skeletal cases?		
Extra-oral appliances	84	80.8
Intra-oral removable appliances	14	13.5
Intra-oral fixed appliances	26	25
3. How often do you use headgear for dentofacial orthopedic treatment in your practice?		
Always	2	1.9
Usually	22	21.2
Rarely	59	56.7
Never	21	20.2
4. How often do you use functional appliances for dentofacial orthopedic treatment in your practice?		
Always	14	13.5
Usually	55	52.9
Rarely	29	27.9
Never	6	5.7
5. Which type of the following functional appliances do you prefer to use in correcting Skeletal Class II cases? (may choose up to 3)		
Twin Block	76	73.1
Activator	14	13.5
Bionator	10	9.6
Frankel II	6	5.8
Herbst	24	23.1
MARA	9	8.7
Forsus	59	56.7
6. Which device do you think will achieve better results in a case of skeletal Class II due to prognathic maxilla?		
Headgear	78	75
Functional appliance	12	11.5
No difference	14	13.5
7. Which device do you think will achieve better results in a case of skeletal Class II due to retrognathic mandible?		
Headgear	0	0
Functional appliance	94	90.4
No difference	10	9.6
8. Which device do you think will achieve better results in a case of skeletal Class III due to retrognathic maxilla?		
Face mask	97	93.3
Functional appliance	6	5.8
No difference	1	0.96
9. Which device do you think will achieve better results in a case of skeletal Class III due to prognathic mandible?		
Chin-cup	42	40.4
Functional appliance	19	18.3
No difference	43	41.3

less of experience more likely to select fixed functional appliances while those with more than 10 years more likely to select the removable type. Moreover, a statistically significant association was present with the location of the orthodontic residency ($p < 0.01$), with residents of European or Middle Eastern training programs more probably to choose removable functional appliances while those trained in a North American program more probably to choose the fixed type. Figure 1 shows that majority of orthodontists of different training backgrounds had the Twin Block as the most preferred device, except for those of North American training preferred the Herbst or its

variation as the primary functional appliance.

The most important factor orthodontists considered routinely before selecting the type of functional appliance was the patient's compliance; followed by the availability of the appliance in the market; and whether they have trained on it during their residency program. The least frequently considered factor was the estimated cost of the appliance to be used (Figure 2).

DISCUSSION

The current study investigated the response of

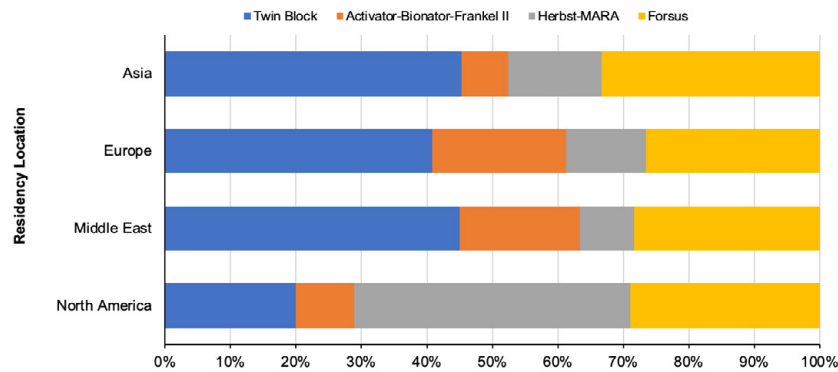


Figure 1: Distribution of different types of functional appliances preference based on residency training.

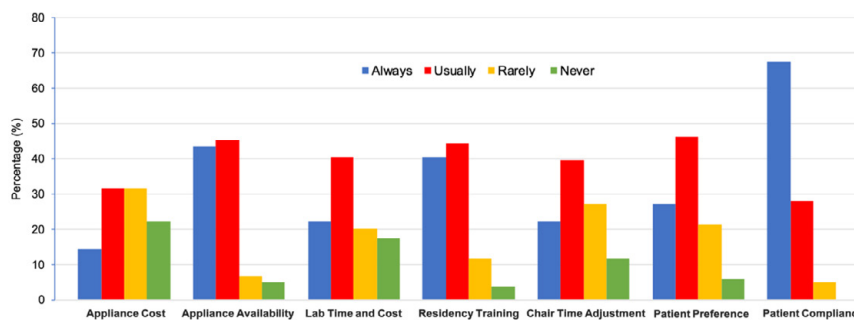


Figure 2: Factors considered in selecting the type of functional appliance.

Table 3: Association between the type of functional appliance selected and demographics.

Variable	Functional appliances		p-value	
	Removable n (%)	Fixed n (%)		
Gender	Male	73 (52.1)	67 (47.9)	0.542
	Female	33 (56.9)	25 (43.1)	
Years of experience	10 or less	53 (46.5)	61 (53.5)	0.03*
	>10	51 (62.2)	31 (37.8)	
Orthodontic residency	Asia	22 (52.4)	20 (47.6)	0.005**
	Europe	30 (61.2)	19 (38.8)	
	Middle East	38 (63.3)	22 (36.7)	
	North America	13 (28.9)	32 (71.1)	
	Other	3 (50)	3 (50)	
Current practice	Central	42 (53.2)	37 (46.8)	0.941
	Eastern	21 (55.3)	17 (44.7)	
	Western	33 (55)	27 (45)	
	Other	10 (47.6)	11 (52.4)	
Working sector	Private practice	75 (56.8)	57 (43.2)	0.192
	Teaching Institution	28 (43.1)	37 (56.9)	
	Governmental Hospital	21 (52.5)	19 (47.5)	

* Statistically significant P<0.05, ** Statistically significant P<0.01

orthodontists practicing in Saudi Arabia toward main orthopedic devices used for dentofacial growth modification, their preferred types of functional appliances, the criteria they depend on for selection of a specific type of functional appliance, and finally factors considered in the prediction of patient’s compliance toward functional appliance use. Since orthodontists participated in the study characterized by the diversity of their training background

representing different schools’ concepts across the globe, it will be interesting to investigate their practice toward the topic which will reflect on the overall nature of practice in Saudi Arabia.

Our study showed that the preference of orthodontists for the orthopedic appliance used depended on the type of skeletal discrepancy. Most of the practitioners preferred intra-oral over extra-oral appliances in treating skeletal Class II discrepancies regardless of the jaw

affected. However, upon specifying the affected jaw 75% of orthodontists think that headgear will achieve better results in case of maxillary prognathism while the majority (90.4%) agreed that functional appliances will achieve better results if the deformity was due to a retrognathic mandible. On the other hand, extra-oral appliances were the highest preferred for skeletal Class III discrepancies (80%) despite which jaw was affected. This was confirmed when the cause of the discrepancy was due to maxillary retrognathia as orthodontists unanimously considered the Face-mask will achieve better results than functional appliances. However, in case of mandibular prognathism there was no agreement on the type of appliance since many think no difference in results achieved by either Chin-cup or functional appliance.

Earlier studies indicated that the dominating devices for growth modification were highly related to the region of training and practice. European practitioners favored Intra-oral removable appliances as a main approach for growth modification; on the other hand, American practitioners preferred extra-oral appliances for management of their cases [3,5,9]. There is some controversy in the literature regarding the most suitable orthopedic device for skeletal discrepancies depending on the affected jaw. Several studies indicated that headgear promoted mandibular growth in Class II cases and the results were comparable to those obtained by functional appliances [10-12]. Other studies advocated the idea that headgear is only effective in restricting maxillary growth with no or little impact on mandibular growth [9,13,14]. In the same context, functional appliances such as Activators or Bionators were recommended for mandibular retrognathic cases in order to promote mandibular growth [9,14-16]. In addition, studies investigated their effect on maxillary growth revealed that they had some restrictive effect but not as effective as headgear [9,12,16]. In regard to skeletal Class III discrepancy, the Face-mask was advocated for protraction of deficient maxilla while evidence from systematic reviews showed that Chin-cup and functional appliances have some restrictive effect on the mandible in cases of prognathic mandible [17,18]. Evidence from Randomized controlled trials indicated that Face-mask could resolve cases of mandibular

protrusion in comparison to untreated controls and treatment better to be followed with Chin-cup use until growth cessation [18,19]. However, no evidence showed that Chin-cup or functional appliances could stimulate maxillary growth [18]. In general, there is evidence that orthopedic appliances can be used in correcting Class III skeletal discrepancy at least on the short term, still further studies are needed on the long term [17,18,20].

The preference for the use of headgears and functional appliances in this study revealed the predominant use of functional devices over headgears. Over 65% of participants use functional appliances routinely comparing to 23% for headgear use. Moreover, less than 6% never used functional while around 20% of participants never used headgears appliances in their practice. In consistence with our study, functional appliances were the most commonly used orthopedic devices by Brazilian orthodontists [8]. US studies in the early 1980s showed that orthodontists had limited use of functional appliances (10%) on a routine basis and more than one third of the practitioners never used them [3-5]. However, over the following decade there was a gradual increase in functional devices use (25%), and nowadays more than 70% incorporate them in their daily practice [3-5]. On the other hand, headgear showed an opposite course of popularity. It was very popular among US orthodontic offices with almost two-third of practitioners routinely using it as the main growth modification device and only less than 5% never used it before [3]. However, the use of headgear declined over the years and recent studies demonstrated that less than 25% use them on a routine basis [4,5]. Although removable functional appliances were predominantly used in the European region; however, headgear was frequently used and showed a respectable increase in practice within the recent years [21,22].

This study revealed that the top three most favored functional appliances among orthodontists in Saudi Arabia were the Twin Block appliance (73%), Forsus (56.7%) and Herbst (23%). Other types of functional appliances such as Activator, Bionator or MARA were of less preference. Consistent with our findings, surveys involved British and Australian

orthodontists showed that Twin Block was the most favored functional appliance [6,7]. In addition, Forsus was commonly used among the Australian Society of Orthodontists [7]. In the early 1980s and before the introduction of the various types of fixed functional devices in the US market and their use in training programs 51% of orthodontists were commonly using the Bionator as the main functional appliance [3]. Gradually, fixed functional appliances gained high popularity among different orthodontic practices in the US and the Herbst considered the most favored appliance with more than 70% preference; followed by the Forsus appliance (26%) [5,23].

Our results showed a statistically significant association between the type of functional appliance preferred and orthodontists' years of experience ($p < 0.05$); however, the strength of the association was of a weak nature (Cramer's $V = 0.155$). Less experienced practitioners more likely to lean toward fixed functional appliances use while those with experience over 10 years more likely preferer the removable type. Furthermore, there was a statistically significant association between the type of functional appliance preferred and the orthodontic residency location ($p < 0.01$) and it was of a moderately strong nature (Cramer's $V = 0.267$). Practitioners who trained in European or North American training programs reflected in their choice for the type of functional appliance the nature of training in those programs. Those of European training background tend to prefer removable functional appliances while those of North American training tend to lean toward the fixed type. The preference of removable appliances by trainees of the Middle Eastern programs reflected a nature and trend similar to that of European countries [6,7].

The findings from the current study revealed the factors considered in selecting the type of functional appliance and were prioritized according to their preference. The topmost three factors were patient's compliance, appliance availability, and appliance previous residency training. Interestingly, the cost of the appliance was among the least considered factors. It is difficult to compare such factors because of the limited present literature that barely covers such topic. In consistent with our finding a recent study of fixed functional appliances

preferences found that among the major factors considered in their device selection was previous device experience and training while the cost involved was among the least [23]. Moreover, patient's compliance and behavior considered as major factors for treatment success with less important consideration for patient's financial capability [24]. Patient's compliance appeared to be related to several factors such as desire for treatment, relationship with orthodontists, and the perception and awareness of the existing malocclusion [25]. Based on the current results further studies are needed to provide better understanding of factors involved in functional appliance selection.

CONCLUSION

Orthodontists practicing in Saudi Arabia revealed a predominant use of functional appliances for dentofacial orthopedic treatment. Headgear was rarely used and limited to cases of skeletal Class III discrepancy. The trend in using the functional appliances was similar to the European trend with a higher preference of use for removable functional appliances over the fixed type and the most preferred functional appliance was the Twin Block.

Selecting the type of functional appliance was influenced by orthodontists' years of experience and location of their residency training. Moreover, orthodontists think that patient's compliance was the main factor affecting their selection. It is suggested that further studies are needed to investigate such factors as limited literature was found.

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