Effects of Fixed Labial Orthodontic Appliances on Oral Functions in Arabic Speaking Children

Original Article

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ABSTRACT

Background: Fixed orthodontic Appliances can change oral functions regarding chewing, swallowing, dietary habits, and speech during the early stages of orthodontic therapy.

Objective: This study aimed to explore the impact of fixed labial orthodontic appliances on speech sound production and the oral phase of swallowing in Arabic-speaking Egyptian children in order to raise the patient's awareness about the expected outcomes of this line of therapy.

Patients and Methods: The study was conducted on 14 children aged 6-18 years of both genders undergoing orthodontic treatment at the Orthodontic Department, Faculty of Dentistry, Mansoura University. The study excluded children with extracted teeth, faulty oral habits related to orthodontic deformity, previous orthodontic treatment, cleft palate, neurological disorders, or delayed language development. The patients were subjected to full vocal tract examination and subjective language evaluation. Then bedside swallowing and chewing evaluation of all consistencies and speech sound evaluation were done before fixed labial orthodontic treatment, after one week and after one month.

Results: Fixed labial orthodontics affected chewing as regards chewing speed, chewing duration and led to chewing discomfort and chewing sialorrhea. They also caused certain food restrictions and bad mouth odor. Swallowing evaluation parameters revealed a significant increase in the presence of oral residue with solids and semisolids. Fixed labial orthodontics affected anterior fricatives (/s/,/z/,/s/,/z/ and /ʃ,/f/), lingo-alveolars (/t/,/t/,/d/,/d/,/l/ and /n (/and bilabials (/b/ and /m/) but did not reach significance after one week and then starts to improve after one month.

Conclusion: Fixed labial orthodontics affect oral functions, especially in the early stages of treatment.

Key Words: Chewing, oral functions, orthodontics, speech, swallowing.

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INTRODUCTION

Fixed appliance treatment has become an essential part of modern orthodontics and a central focus of orthodontic research. Labial fixed orthodontic appliances are placed on the teeth' outer (labial) surface; that is why they are named labial appliances[1].

All intraoral appliances used by orthodontists produce changes in oral functions because they act as a foreign body. The appliance occupies a space within the oral cavity, reducing the intraoral vertical dimension, limiting tongue movement. Therefore, appliance users will have to adapt to them, especially after the first month of use[2].

Orthodontic fixed appliances also affect dietary habits. Patients usually need to change their diet, especially what they eat and how they prepare the food.

Speech sound production is a complicated and precise process involving different articulators' planning, coordination, and movement. Those articulators are the jaw, lips, teeth, tongue, palate, cheeks, and larynx. Placement of fixed labial appliances has affects on speech sound production especially /s/, /f/, /v/, /t/, /r/, /n/, and /l/ phonemes[3].

Any dental appliance (orthodontic or prosthetic) can cause errors in articulation of linguodental, labiodental, or linguoalveoler consonants. However, speech is a learned process, and the articulators have a remarkable capacity for adaptation. Thus, even when severe anatomical limitations are present, normal speech can be observed[4].

This study aimed to explore the impact of fixed labial orthodontic appliances on speech sound production and the oral phase of swallowing in Arabic-speaking Egyptian children in order to raise the patient's awareness about the expected outcomes of this line of therapy.

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PATIENTS AND METHODS:

2.1. Study design:

Pre- and Post-Interventional study was developed in the Phoniatric Unit, Mansoura University Hospitals and orthodontic department, Faculty of Dentistry, Mansoura University from May 2019 to April 2020.

2.2. Subjects:

Children undergoing fixed labial orthodontic treatment aged 6-18 years of both genders were included in the study. The study excluded children with extracted teeth, faulty oral habits related to orthodontic deformity, previous orthodontic treatment, cleft palate, neurological disorders, or delayed language development. All patients were subjected to complete vocal tract examination and subjective language evaluation.

2.3. Methods:

The oral functions of the children were assessed before the fixed labial orthodontic treatment, after one week, and after one month. The children were subjected to a bedside swallowing and chewing evaluation of all consistencies and speech sound evaluation. Bedside swallowing evaluation included chewing (1/4 of a biscuit) to assess the oral preparatory phase. The evaluation parameters included: Incision – Chewing pattern – Chewing duration – Chewing speed – Labial sealing – Noise – Discomfort – Restricted food – Bad mouth odor – Weight (Appendix). All of our patients were instructed not to eat the following: pears, apples, red dates, carrots, peaches, cucumber, corn-on-the-cob, toffee, chewing gums, pulp, eastern sweets, nuts, chocolate, potato chips, rusk, ice, and soft drinks.

All of the studied children were subjected to an oral examination (post swallowing) of all consistencies: liquid (5ml water), semisolid (5ml), and solids (1/4 of a biscuit). Labial sealing, lower lip Position, contraction of the orbicularis muscle, head movement, noise, and residue in the oral cavity were assessed. Each trial was repeated three times to obtain the average score (Appendix).

All the studied children were evaluated by Mansoura Arabic Articulation Test (MAAT) [5]. MAAT is a valid and reliable test that can be applied to test the phonetic inventory of Arabic-speaking young children. It has been designed to include all the Colloquial Egyptian Arabic consonants (CEA) in all positions in the word. Each sound was given a score as the following: (Normal 0 – Imprecision 1– Distortion II – Omission III – Substitution IV).

2.4. Ethical consideration:

The research procedures were conducted following the principles of the Declaration of Helsinki. Informed consent was obtained from the parent of each participant in the study after assuring confidentiality. Patients had the right to withdraw from the study at any time during the study without penalty. . The study protocol was approved by the institutional research board (IRB), Faculty of Medicine, Mansoura University (MS.19.04.573).

2.5. Data analysis:

The Chi-square test was used to test the association between categorical variables. It was replaced by Fisher's Exact Test if the expected cell count was less than 5 in four-cell tables, while it was replaced by the Monte Carlo test if the expected cell count was less than 5 in more than four-cells tables. The one-way analysis of variance (ANOVA) was used to determine any statistically significant differences between the means of two or more independent (unrelated) groups. Association between normally distributed continuous variables was tested using an independent sample t-test in 2 independent groups. Results were considered significant when the probability of error was less than or equal to 5% ($p \leq 0.05$).

RESULTS:

3.1. Descriptive Statistics:

The study was conducted on a sample of 14 children in the age range 6 – 18 years (13.4 ± 2.4). It included nine males (64.3%) and five females (35.7%). 4 children (28.6%) were urban, and 10 (71.4%) were from rural areas (Table 1).

Table 1: Demographic characteristics of the studied group (N=14)

Parameters	Items	n= 14
	mean ± sd	13.4 ± 2.4
Address	□ Urban	4 (28.6%)
	□ Rural	10 (71.4%)
Gender	□ Male	9 (64.3%)
	□ Female	5 (35.7%)

Data expressed as number (%) or mean ± sd.

3.2. Results of chewing:

Chewing evaluation, after one week, revealed significant affection than before in chewing speed, chewing duration, chewing discomfort, chewing sialorrhea, restricted food, and bad mouth odor (Table 2).

Table 2: Chewing functions in the studied children before fixed labial orthodontic appliances, after 1- week and after 1-month evaluations (N=14)

Parameters	Before	After 1 week	After 1 month	P1	P2	P3
Incision						
Anterior	10 (71.4%)	7 (50%)	11 (78.6%)	χ^2= 2.1 *P= 0.42*	χ^2= 1.1 *P =0.91*	χ^2= 2.6 *P= 0.37*
Lateral	4 (28.6%)	7 (50%)	3 (21.4%)			
Chewing pattern						
Bilateral alternated	12 (85.7%)	9 (64.3%)	9 (64.3%)	FET *P= 0.55*	FET *P= 0.55*	χ^2= 3.7 *P= 0.99*
Bilateral simultaneous	2 (14.3%)	5 (35.7%)	5 (35.7%)			
Chewing speed						
Appropriate	14 (100%)	3 (21.4%)	8 (57.1%)	χ^2= 18.1 *P ≤ 0.001**	FET *P= 0.02**	χ^2= 3.7 *P= 0.053*
Decreased	0	11 (78.6%)	6 (42.9%)			
Chewing duration "*per seconds*"	14.4 ± 2.2	19.1 ± 2.5	16.8 ± 2.7	t= 5.3 *P ≤ 0.001**	t= 2.5 *P= 0.02**	t= 2.3 *P= 0.03**
Labial sealing						
Appropriate	14 (100%)	10 (71.4%)	13 (92.9%)	FET *P= 0.14*	FET *P= 0.95*	FET *P= 0.28*
Partial	0	4 (28.6%)	1 (7.1%)			
Chewing discomfort						
No	14 (100%)	0	7 (50%)	MC= 28.0 *P ≤ 0.001**	FET *P= 0.002**	MC= 19.6 *P ≤ 0.001**
Degree I	0	3 (21.4%)	7 (50%)			
Degree II	0	11 (78.6%)	0			
Chewing sialorrhea						
No	14 (100%)	8 (57.1%)	11 (78.6%)	MC= 7.6 *P= 0.02**	FET *P= 0.22*	MC= 4.7 *P= 0.09*
Degree I	0	2 (14.3%)	3 (21.4%)			
Degree II	0	4 (28.6%)	0			
Restricted food						
No	14 (100%)	0	0	χ^2= 28.1 *P ≤ 0.001**	MC= 28.0 *P ≤ 0.001**	FET *P= 0.99*
Degree I	0	14 (100%)	13 (92.9%)			
Degree II	0	0	1 (7.1%)			
Bad mouth odor						
Absent	14 (100%)	6 (42.9%)	8 (57.1%)	FET *P= 0.002**	FET *P= 0.02**	χ^2= 0.57 *P= 0.71*
Present	0	8 (57.1%)	6 (42.9%)			
Weight of children *in (Kg)*	43.7 ± 9.4	42.9 ± 9.6	42.9 ± 9.6	t= 0.05 *p= 0.98*	t= 0.05 *p= 0.98*	t= 0.01 *p= 0.99*

Data expressed as number (%) or mean ± sd. MC: Monte Carlo test.
*: significant $p \leq 0.05$. F: One Way ANOVA test.
FET: Fisher's Exact Test χ^2: chi-square test.
P1: Before vs after 1-week.
P2: Before vs after 1-month. t: independent samples t test. P3: After 1-weak vs after 1-month.

After one week, the chewing speed decreased in (78.6%) of patients and was still decreased in (42.9%) after one month. Chewing duration changed from 14.4 ± 2.2 seconds before treatment to 19.1 ± 2.5 seconds after one week to 16.8 ± 2.7 after one month. Chewing discomfort was a common complaint in all patients after one week of therapy (21.4% were degree 1 and 78.6% were degree II). After one month, (50%) of patients had no chewing discomfort, and (50%) had grade I. There was restricted food for all patients during one week and one month of evaluation. Many patients reported that they had difficulty eating meat and chicken dishes. Bad mouth odor was present in (57.1%) after one week and in (42.9%) after one month. After one week, chewing sialorrhea degree I was noticed in (14.3%) and (28.6%) degree II. Also, (21.4%) of patients still had chewing sialorrhea grade I after one month. Children's weight also showed minor changes after therapy from 43.7 ± 9.4 kg before therapy to 42.9 ± 9.6 kg after one week and after one month.

3.3. Results of Swallowing:

As regards swallowing parameters, the oral residue of solids and semisolids showed a significant increase after one week and after one month than before the fixed

labial orthodontic therapy. Evaluation of swallowing of semisolids, after one-week, revealed that (57.1%) showed much residue, and (28.6%) had minimal residue. Evaluation of swallowing of semisolids, after one month, revealed that (21.4%) of patients had much residue, and (71.4%) had minimal residue. Evaluation of swallowing of solids, after one week, revealed that (64.3%) showed much residue and (35.7%) had minimal solids residue. Evaluation of swallowing of solids, after one month, revealed that (28.6%) of patients had much residue, and (64.3%) had minimal residue (Table 3).

Table 3: Swallowing functions in the studied children before fixed labial orthodontic appliances, after 1- week and after 1-month evaluations (N=14)

I- *Liquids*						
Parameters	Before	After 1 week	After 1 month	P1	P2	P3
Labial sealing						
Appropriate	14 (100%)	12 (85.7%)	14 (100%)	FET	FET	FET
Partial	0	2 (14.3%)	0	*P= 0.56*	*P= 1.0*	*P= 0.56*
Lower lip position						
Touch upper lip	12 (85.7%)	10 (71.4%)	11 (78.6%)	FET	FET	FET
Behind upper incisors	2 (14.3%)	4 (28.6%)	3 (21.4%)	*P= 0.66*	*P= 0.95*	*P= 0.95*
Contraction of orbicularis muscle						
Appropriate	13 (92.9%)	13 (92.9%)	14 (100%)	FET	FET	FET
Mild	1 (7.1%)	1 (7.1%)	0	*P= 1.0*	*P= 0.95*	*P= 0.95*
II- *Semisolids*						
Parameters	Before	After 1 week	After 1 month	P1	P2	P3
Labial sealing						
Appropriate	14 (100%)	10 (71.4%)	13 (92.9%)	FET	FET	FET
Partial	0	4 (28.6%)	1 (7.1%)	*P= 0.13*	*P= 0.95*	*P= 0.22*
Lower lip position						
Touch upper lip	11 (78.6%)	9 (64.3%)	9 (64.3%)	FET	FET	FET
Behind upper incisors	3 (21.4%)	5 (35.7%)	5 (35.7%)	*P= 0.81*	*P= 0.81*	*P= 1.0*
Contraction of orbicularis muscle						
Appropriate	12 (85.7%)	10 (71.4%)	11 (78.6%)			
Mild	2 (14.3%)	4 (28.6%)	3 (21.4%)	FET	FET	FET
Sever				*P= 0.91*	*P= 0.95*	*P= 0.96*
Residue in oral cavity						
Absent	11 (78.6%)	2 (14.3%)	1 (7.1%)			
Minimal	3 (21.4%)	4 (28.6%)	10 (71.4%)	MC=14.4	MC=15.1	MC= 5.2
Much	0	8 (57.1%)	3 (21.4%)	*P=0.001**	*P≤0.001**	*P= 0.09*
III- *Solids*						
Parameters	Before	After 1 week	After 1 month	P1	P2	P3
Labial sealing						
Appropriate	14 (100%)	10 (71.4%)	13 (92.9%)	FET	FET	FET
Partial	0	4 (28.6%)	1 (7.1%)	*P= 0.14*	*P= 0.95*	*P= 0.28*
Lower lip position						
Touch upper lip	11 (78.6%)	9 (64.3%)	9 (64.3%)	FET	FET	FET
Behind upper incisors	3 (21.4%)	5 (35.7%)	5 (35.7%)	*P= 0.81*	*P= 0.81*	*P= 1.0*
Contraction of orbicularis muscle						
Appropriate	12 (85.7%)	7 (50%)	8 (57.1%)	MC= 5.1	FET	MC= 1.9
Mild	2 (14.3%)	6 (42.9%)	6 (42.9%)	*P= 0.19*	*P= 0.23*	*P= 0.94*
	0	1 (7.1%)	0			

Residue in oral cavity							
□	Absent	10 (71.4%)	0	1 (7.1%)	MC=19.1 *P≤0.001**	MC=13.3 *P=0.001**	MC= 4.1 *P= 0.13*
□	Minimal	4 (28.6%)	5 (35.7%)	9 (64.3%)			
□	Much	0	9 (64.3%)	4 (28.6%)			

Data expressed as number (%). MC: Monte Carlo test. *: significant $p \leq 0.05$.
FET: Fisher's Exact Test. P1: (Before vs after 1- week).
P2: (Before vs after 1-month). P3: (After 1-weak vs afte month).

3.4. Results of Speech:

As for evaluation of the speech before the fixed labial orthodontic therapy, some children showed some sound affection due to the different types of malocclusion as class II malocclusion, anterior open bite, severe crowding and maxillary protrusion. The most affected sounds were anterior fricatives (/s/, /z /, /s/, /z/, /ʃ/ and /f/) and to a lesser extent (/t/, /t/, /d, /d/). (21.4%) of patients showed imprecision of (/s/, /z, /s/, /z/) sounds, (35.7%) showed distortion and (14.3%) showed substitution. Also, (28.6%) of children showed imprecision of /ʃ/ sound and (28.6%) showed distortion. As regard /f/ sound and lingo-alveolar plosives (/t/, /t/, /d, /d/), (14.3%) of patients had imprecision during their sound production. Other speech sounds were normal.

Speech evaluation after one week of fixed labial orthodontic therapy showed more change than before treatment. Anterior fricatives (/s/, /z, /s/, /z/) were distorted in (64.3%) and substituted in (21.4%). /ʃ/ sound was distorted in (57.1%), omitted in (7.1%) presented and substituted in (7.1%). /f/ sound was impercised in (42.9%) and distorted in (14.3%). Lingo-alveolars (/t/, /t/, /d, /d/) were impercised in (35.7%). /l/ sound was impercised in (21.4%). Bilabials (/b/ and /m/) were imprecised in (7.1%) and (14.3%) respectively.

Speech evaluation after one month showed improvement than after one-week evaluation mainly due to adaptation to the appliance. Lingo-alveolars (/t/, /t/, /d/, /d/, /l/ and /n (/ and bilabials (/b/ and /m/) returned to pretreatment results. Anterior fricatives (/s/, /z/, /s/, /z/) improved as (50%) of patients had distortion, (14.3%) had substitution and (7.1%) had imprecision. /ʃ/ sound also improved as (42.9%) had distortion and (14.3%) had imprecision. /f/ sound also showed improvement as (14.3%) of patients had imprecision and (7.1%) had distortion (Table 4).

Table 4: Articulation test in the studied children before fixed labial orthodontic appliances, after 1- week and after 1-month evaluations (N=14):

		Parameters	Before	After 1 week	After 1 month	P1	P2	P3
/b/	□	Normal	13 (92.9%)	12 (85.7%)	13 (92.9%)	FET *P= 0.95*	FET *P= 0.99*	FET *P= 0.95*
	□	Imprecision	1 (7.1%)	2 (14.3%)	1 (7.1%)			
/t/	□	Normal	12 (85.7%)	9 (64.3%)	12 (85.7%)	FET *P= 0.49*	FET *P= 0.99*	FET *P= 0.49*
	□	Imprecision	2 (14.3%)	5 (35.7%)	2 (14.3%)			
/d/	□	Normal	12 (85.7%)	9 (64.3%)	12 (85.7%)	FET *P= 0.49*	FET *P= 0.99*	FET *P= 0.49*
	□	Imprecision	2 (14.3%)	5 (35.7%)	2 (14.3%)			
/z/	□	Normal	4 (28.6%)	2 (14.3%)	4 (28.6%)			
	□	Imprecision	3 (21.4%)	0	1 (7.1%)	MC=4.8 *P= 0.57*	MC=3.9 *P= 0.65*	MC= 3.6 *P= 0.69*
	□	Distortion	5 (35.7%)	9 (64.3%)	7 (50%)			
	□	Substitution	2 (14.3%)	3 (21.4%	2 (14.3%)			
/s/	□	Normal	4 (28.6%)	2 (14.3%)	4 (28.6%)			
	□	Imprecision	3 (21.4%)	0	1 (7.1%)	MC=4.8 *P= 0.57*	MC=3.9 *P= 0.65*	MC= 3.6 *P= 0.69*
	□	Distortion	5 (35.7%)	9 (64.3%)	7 (50%)			
	□	Substitution	2 (14.3%)	3 (21.4%)	2 (14.3%)			
/ʃ/	□	Normal	6 (42.9%)	4 (28.6%)	6 (42.9%)			
	□	Imprecision	4 (28.6%)	0	2 (14.3%)			
	□	Distortion	4 (28.6%)	8 (57.1%)	6 (42.9%)	MC=8.9 *P= 0.29*	MC=8.9 *P= 0.29*	MC= 2.7 *P= 0.82*
	□	Omission	0	1 (7.1%)	0			
	□	Substitution	0	1 (7.1%)	0			

/s/	□	Normal	4 (28.6%)	2 (14.3%)	4 (28.6%)			
	□	Imprecision	3 (21.4%)	0	1 (7.1%)	MC=4.8	MC=3.9	MC= 3.6
	□	Distortion	5 (35.7%)	9 (64.3%)	7 (50%)	*P= 0.57*	*P= 0.65*	*P= 0.69*
	□	Substitution	2 (14.3%)	3 (21.4%)	2 (14.3%)			
/d /	□	Normal	12 (85.7%)	9 (64.3%)	12 (85.7%)	FET	FET	FET
	□	Imprecision	2 (14.3%)	5 (35.7%)	2 (14.3%)	*P= 0.49*	*P= 0.99*	*P= 0.49*
/t/	□	Normal	12 (85.7%)	9 (64.3%)	12 (85.7%)	FET	FET	FET
	□	Imprecision	2 (14.3%)	5 (35.7%)	2 (14.3%)	*P= 0.49*	*P= 0.99*	*P= 0.49*
/z/	□	Normal	4 (28.6%)	2 (14.3%)	4 (28.6%)			
	□	Imprecision	3 (21.4%)	0	1 (7.1%)	MC=4.8	MC=3.9	MC= 3.6
	□	Distortion	5 (35.7%)	9 (64.3%)	7 (50%)	*P= 0.57*	*P= 0.65*	*P= 0.69*
	□	Substitution	2 (14.3%)	3 (21.4%)	2 (14.3%)			
/f/	□	Normal	12 (85.7%)	6 (42.9%)	11 (78.6%)			
	□	Imprecision	2 (14.3%)	6 (42.9%)	2 (14.3%)	MC=10.2	MC=1.2	MC=9.7
	□	Distortion	0	2 (14.3%)	1 (7.1%)	*P= 0.19*	*P= 0.95*	*P= 0.24*
/l/	□	Normal	13 (92.9%)	11 (78.6%)	13 (92.9%)	FET	FET	FET
	□	Imprecision	1 (7.1%)	3 (21.4%)	1 (7.1%)	*P= 0.66*	*P= 0.99*	*P= 0.92*
/m	□	Normal	13 (92.9%)	12 (85.7%)	13 (92.9%)	FET	FET	FET
	□	Imprecision	1 (7.1%)	2 (14.3%)	1 (7.1%)	*P= 0.95*	*P= 0.99*	*P= 0.95*
/n/	□	Normal	13 (92.9%)	13 (92.9%)	13 (92.9%)	FET	FET	FET
	□	Imprecision	1 (7.1%)	1 (7.1%)	1 (7.1%)	*P= 1.0*	*P= 1.0*	*P= 1.0*

Data expressed as number (%). FET: Fisher's Exact Test.
MC: Monte Carlo test. not significant: $p > 0.05$. P1: (Before vs after 1- week).
P2: (Before vs after 1-month). P3: (After 1-weak vs after 1 month)

DISCUSSION

The results of our study as regard chewing and swallowing were consistent with the other studies. Trein *et al*.[6] assessed chewing in 10 patients of both genders undergoing fixed orthodontic treatment. The masticatory performance was assessed before activating the orthodontic appliance, 24 hours after activation, and 30 days after activation. They reported that increased pain had led to a reduced masticatory performance with no affection of particle size during swallowing. Chewing performance decreased immediately after appliance placement, and after extended follow-up, chewing performance became similar to the one obtained before appliance insertion[7].

Banerjee *et al*.[8] assessed pain severity in adolescents undergoing fixed orthodontic treatment during different phases of treatment. They reported severe to moderate pain in the initial phase of treatment, especially after one day. Then over a week, the pain reduced, and patients had moderate to mild pain after one month. Orthodontic brackets cause mucosal erosions, whereas archwires cause ulcerations which leads to pain[9].

Hafiz *et al*.[10] examined the relationship between quality of life and fixed appliances by asking patients to answer a questionnaire regarding diet changes, pain perception, physical changes, and psychological effects. The results showed that 76.5% had difficulties in eating, 45% in speaking, 74.5% pain, and 41% complained of diet restrictions.

Al Jawad *et al*.[11] studied the early effects of fixed orthodontic treatment on adolescents' dietary intake and body weight after 4-6 weeks and three months. Patients reported changes in their diet response to pain, inability to chew, and dietary instructions given to them by their orthodontist. The impact on dietary behavior was significantly higher at 4-6 weeks. The authors reported no significant changes in energy, macronutrient, body mass index, and fat percentage. The adaptation mechanisms such as shifting to other food and drink items, cutting food into pieces, and cooking differently might have decreased the effects of fixed orthodontic treatment on dietary intake and body fat composition. These adaptation mechanisms might explain that there were no significant changes in body weight of the evaluated children.

Li *et al*.[12] studied the effects of fixed orthodontic appliances on saliva flow rate and saliva electrolyte concentrations. Saliva flow rates were measured four times before treatment, one month, three months, and six months and analyzed for electrolyte concentrations.

The study reported increased saliva flow rate and changes in saliva electrolytes early after placing fixed orthodontic appliances. That was due to increased mechanical stimulation, so patients needed some time to adapt to the appliances.

Thilagrani *et al*.[13] studied periodontal health with orthodontic appliances and found increased retention of food debris in the oral cavity. Oral hygiene during orthodontic treatment was exceedingly complicated after the placement of fixed orthodontic appliances. So, failure to maintain oral hygiene may affect the corrected malocclusion due to periodontal disease or caries[14].

While the results of this study revealed significant affection than before, after one week and one month, in chewing speed, chewing duration, chewing discomfort, chewing sialorrhea, restricted food, bad mouth odor and oral residue in semisolids and solids after the swallow, Navarro *et al*.[2] demonstrated contrary results. They found no statistically significant changes in all chewing parameters after one month of use of intraoral appliances. The study explained that chewing results are due to the adaptation of the stomatognathic system to the appliance.

Our results of speech evaluations did not reach significance because of the small sample size, but they are consistent with the results of Navarro *et al*.[2]. The latter evaluated the speech of patients aged (10 to 24) years undergoing fixed orthodontic treatment. They reported statistically significant changes only in speech, especially distortion of consonants in 25% of patients, especially anterior fricatives.

Our results agree with Paley *et al*.[3], who evaluated patients' speech with fixed labial appliances. The speech was evaluated before appliance insertion, immediately following insertion and 1 and 2 months post-insertion. The study reported that fixed labial appliances had variable negative effects on speech sound production in most patients (57%). 17% of all patients continued to show changes in sound errors after two months. The most affected sounds were /s/, /ʧ/, /dz/, /f/, /ʃ/ /t/ but /s/ and /t/ were the most affected phonemes. They also reported that adaptation to fixed appliances is variable and depends on the severity of the malocclusion.

Many studies compared fixed labial orthodontics and fixed lingual orthodontics regarding speech. One of them, Chen *et al*.[15], who studied the effect of various types of orthodontic appliances on speech, reported that speech difficulties caused by labial appliances were less noticeable than other types. Speech errors were caused immediately after placement of labial fixed appliance, resolved within weeks. The placement of labial appliances led to a direct interaction between the labial brackets and lips and anterior teeth. This can alter touch perception and lead to pain and tension of articulators. The disturbance in the anterior region of the mouth led to tongue protrusion, which affected the /s/ sound. The duration of the speech distortion caused by labial appliances was diverse. The difference may be due to the individual adaptation ability and the variable severity of the malocclusion.

Khattab *et al*.[16], Ahmed *et al*.[17], Rai *et al*.[18], Caniklioglu *et al*.[19] compared between the labial and lingual fixed orthodontics and reported early speech affection in both groups, but labial appliances were less problematic than the lingual one. There was a significant deterioration in articulation in both groups, which was worst after 24 hours and after one week. Misarticulations in both groups mainly in /s/ (fricative), /d/, /t/, and /l/ increased immediately after bracket placement. The errors in the initial months of the treatment by labial fixed appliance due to pain and tension because of cheek and lip soreness[19]. There was a gradual adaptation to the appliance within few weeks.

Further studies on larger samples should be conducted to study the effects of other orthodontics on oral function with more extended follow-up periods to detect their long-term effects on oral functions. More teamwork cooperation between phoniatricians/ speech-language therapists and orthodontics is needed to help patients with malocclusion and patients seeking orthodontic treatment. Before orthodontic treatment, patients should be oriented about the expected speech and swallowing problems that orthodontic appliances and devices may induce. Counseling should be given regarding the adaptation time.

LIMITATIONS

The small study size was a limitation due to a decreased number of new cases in the orthodontic department, Faculty of Dentistry, Mansoura University. Also, it was due to Coronavirus pandemic precautionary measures as the orthodontic department was closed for a few months. The short follow-up period as orthodontic therapy needed longer follow-up time.

CONCLUSION

Fixed labial orthodontics affected oral functions, especially in the early stages of treatment. Fixed labial orthodontics affected chewing speed, chewing duration, chewing discomfort and led to chewing sialorrhea. They caused certain food restrictions and bad mouth odor due to food residue. Fixed labial orthodontics affected anterior

fricatives (/s/, /z /, /s/, /z/ and /ʃ, /f /), lingo-alveolars (/t/, /t/, /d/, /d/, /l/ and /n (/ and bilabials (/b/ and /m/). These sounds were affected after one week and then started to improve after one month.

CONFLICT OF INTEREST

There are no conflicts of interest.

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Appendix

Mansoura University Hospitals
E.N.T Department
Phoniatrics Unit

مستشفيات جامعة المنصورة
قسم ألانف والاذن والحنجرة
وحـــدة امراض التـخـــاطـــب

Oral Functions Test in Arabic Speaking Children
مقياس الوظائف الفموية في الأطفال المتحدثين بالعربية

Serial Number:	
Name :	
Birth Date :	
Age :	
Home Address	
Phone Number	

□ Assessment Date	
□ Articulation	
□ Chewing	
□ Swallowing	
• Fluids	
• Semisolid	
• Solids	

Articulation

By Mansoura Arabic Articulation Test (MAAT) [5]

0	Normal	1	Impercision	2	Distortion	3	Omission	4	Substitution

Chewing

Incision	Anterior (0)	Lateral (1)	Other (1)
Chewing pattern	Bilateral alternated (0) Unilateral preferential (0)	Bilateral Simultaneous (1)	Chronic Unilateral (2)
Chewing Duration			
Weight of children in (Kg)			
Labial Sealing	Systematic (0)	Unsystematic (1)	Absent (2)
Speed	Appropriate (0)	Increased (1)	Decreased (1)
Restricted Food	No (0)	Degree (I)	Degree (II)
Chewing discomfort	No (0)	Degree (I)	Degree (II)
Noise	Absent (0)		Present (1)
Bad Mouth odor	Absent (0)		Present (1)

Swallowing

Labial Sealing	Appropriate (0)	Partial (1	Absent (2)
Lower Lip Position	Touch upper lip (0)		Behind upper incisor (1)
Contraction of Orbicularis muscle	Appropriate (0)	Mild (1)	Sever (2)
Head Movement	Absent (0)		Present (1)
Noise	Absent (0)		Present (1)
Residue in Oral Cavity	Absent (0)	Minimal (1)	Much (2)