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Effect of Morphological Changes of Maxillary Arch Treated Orthodontically on the Successfulness of Prosthodontic Treatment.

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ABSTRACT

Aims: To evaluate the effects of orthodontic treatment, sex on the maxillary arch measurements, anatomical landmarks position, dimensional differences of artificial teeth selection and position on the comfort for treated partially edentulous patient; with and without previous orthodontic treatment. **Materials and Methods:** two groups of patients: (Males and females) included in this study. First group were with Orthodontic group classified as: Angle class I malocclusion, crowding more than 5 mm, there were 48 in number. Second group were 32 in number, and they're partially edentulous (with previous orthodontic treatment or without as a control group), they were selected with special criteria. A 192 dental stone casts were prepared, and 64 linear measurements were done for each individual cast of the first group, and 22 measurements for the second group. Crom–Cobalt (Cr–Co.) partial dentures were constructed for the second group individuals, follow up for 3–6 months to detect the comfort of the patient in relation to mean differences in the length measurements of the saddle area were recorded. **Results:** Incisal canine dimension showed a marked expansion of right side (0.7342 mm) post orthodontic treatment, constriction in the upper inter 1st molar distance 2.7334 mm in relation to control. Anatomical landmark (canine to hamular notch right and left post orthodontic treatment), in female showed an increase in measurements in relation to male. Length difference of free end saddle area of partially edentulous control group in relation to partially edentulous patient with orthodontic treatment was about 2.987 mm. An increase in percentage of comfort of control patients wearing removable prosthesis was shown in female. **Conclusions:** Mean values of the all measurements were generally higher in the males than females post orthodontic treatment. Increase in the arc measurements, but with constructions in the inter–molar distance, anatomical landmark labial surface of the central incisors to the incisive papilla, and canine to hamular notch for both groups. Length of artificial teeth of free end partially edentulous with orthodontic treatment was reduced, but the comfort after prosthodontic treatment was higher in female of both groups.

Key words: Orthodontics, Prosthetic, comfort, landmark.

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INTRODUCTION

The face by which we greet the world is the most visible part of human body. The maxillary arch dimensions are important in clinical Prosthodontics, Orthodontics, Pedodontics, Oral surgery, and other fields as: Anthropology [(1)]. The orthodontic treatment for any case of malocclusion, certainly aims to create changes in teeth position in a manner to convert malocclusion into an acceptable occlusion that performs the three main demands: function, aesthetic, and phonetic. It is well established that increases in the dental arch length and width during orthodontic treatment tend to return toward pre–treatment values after retention. These dimensional changes may affect arch form and size as well.[(2)] Orthodontic therapy can no longer be isolated from the increasing treatment demands of other specialties.[(3)]

Prosthesis must include a facial eval-

uation along with an intra oral examination when establishing treatment goals that will satisfy the patient and provide aesthetic results. Analysis of facial proportion, integument form, and dento–labial relationship at resting lip position and in a full smile, together with an occlusal evaluation, will help the clinician to design the best functional and aesthetic dental prosthesis [4–6]. Aesthetic factors: the form of face, tooth and arch form, maxillary anterior tooth arrangement and palatal contour [7] and the anatomical landmarks [8,9] were used for selection of suitable tooth moulds for completely and partially edentulous patients. One of the methods of orthodontic treatment of crowding anterior teeth is extracting of bilateral first bicuspid. Extraction of premolars has an effect on the tongue space during development [9]. First bicuspid has a fixative position in relation to the medial fibres' of the buccinators muscle at the corner of the mouth. This position of bicuspid plays an important mechanical function during mastication and plays an important guide of maxillo–mandibular relationship [10]. Aims of the study, were to evaluate the effect of the extraction of the first bicuspid on maxillaary arch measurements, percentage of changes in positions of teeth in relation to anatomical landmarks, and to evaluate the dimensional differences of artificial teeth selection, also the comfortablility of treated partially edentulous patient (with or without previous orthodontics).

MATERIALS AND METHODS

The first participant of this study consists of 48 patients (24 females and 24 males), age range between 15–20 years. The patients were selected from the Dental College University of Mosul. This research was completed between three and a half years (treatment and retention period), and all patients were selected according to special criteria Angle Class I malocclusion crowding more than 5 mm, no molar rotation, no anterior or posterior cross bite, clinically no detectable massive inter proximal or occlusal caries, no dental restorations or fractured or crowned teeth, no supernumerary teeth, and no previous orthodontic treatments.

For each patient after extra and intra oral examination a case sheet was used to fill all information about the patient before and after orthodontic treatment. All patients had undergone fixed orthodontic treatment using edgewise technique 0.022" bracket slot. Extraction of bilateral 1st bicuspid had been done for all patients followed by retraction of canines using sliding mechanism by power chain elastic to full bicuspid width with anchorage reinforcement by using face bow head gear. A total of 192 dental stone casts were constructed for the maxillary and mandibular arches: one set before treatment and the other after final treatment and follow up after removal of retainers (three and a half years). Dental arch relationship was detected, and linear measurements were done five times for each by using digital electronic vernier (LEZACO, China) with accuracy (0.001 mm), and celluloid strip for determination of the arc distance.

A black automatic pencil (0.3 mm tip) was used to mark anatomical landmarks on the maxillary stone cast at two time periods with the aid of surveyor device and special holder to fix the digital vernia: (Pr: pre treatment, C–C: Inter canines distance, M–M1st: inter 1st molar mesio buccal cusps, M–M2nd: inter 2nd molar mesio buccal cusps). Segmental length measurements include: (Cr: Incisor to cusp of right canine, ICl : Incisor to cusp of left canine, CMr: Canine to mesial cusp of 2nd right molar, CMl: Canine to mesial cusp of 2nd left molar, IMo: Vertical distance from Incisal to line between 2nd molars disto–buccal cusp tip. Arc–C: arc measurement from distal canine to distal canine)[8].

Other measurements were done to determine the coincidences of anatomical landmarks in relation to natural teeth position (Pre and post treatment measurements of LI–P: Labial surface of central incisor to the anterior part of incisive papilla, P–IC: Papilla in relation to inter canine line. I–Mr1, I–Ml1: Incisal to mesial buccal cusp of 1st molar right and left. I–M2nd r, I–M2nd l : Incisal to mesial buccal cusp of 2nd molar right and left. C–Hr, C–Hl: Canine to Hamular notch right and left, H–H: Horizontal distance between Hamular to Hamular notches [1,8]. The second participants were thirty two in number, partially edentulous Kennedy Cl II with

missing teeth distal to canine right or left side of the arches, age range: 55–61 years of old, and were divided into:

- Group without previous orthodontic treatment, twenty in number.
- Group with previous orthodontic treatment (with extraction of teeth), twelve in number (very rare clinical cases). After extra and intra oral examination with recording all information, linear measureements of maxillary and mandibular casts were done in addition to the free end saddle area of the side of the maxillary arch from the distal of the canine to the maxillary tuberose area in relation to the 2/3 of retro molar pad, and for the natural teeth of the other side from distal of the canine to distal most posterior teeth [11]. Cr.Co. removable partial acrylic resin denture was constructed in the conventional method with one design, which was anterior–posterior major connector. After insertion of prosthesis intra orally, correction of errors was done with follow up for 2 weeks. Each patient was examined for recording the percentage of comfort of the prosthesis after 3–6 months. Mean, standard deviation, mean differences and Two–tailed correlations between male and female were determined for all the measurements of the parameters before and after orthodontic treatment.

RESULTS AND DISCUSSION

For the first participant: Mean arch dimensions along with their standard deviations, paired differences and correlations, were listed in Tables (1–4). Mean values of the all variables were generally higher in the males compared with the females and significant sex differences in the means $P > 0.001$ [11] for all measurements (pre and post orthodontic treatment) except for C–C, M–M1st, M–M2nd, Icl, and Arc–C. The dimension of ICr showed a marked expansion post treatment as result of relieving of crowded anterior teeth in addition to the distal tipping canines during retraction [12–14]. The results of this study showed a constriction in the upper inter 1st molar distance 2.7334 mm. for the total sample, the results of this study was agreed with Isik *et al* [11], and nearly the same as the results of study that done by Boley *et al* [15] demonstrating a decreased in the inter molar width (–2.1 mm). The results of this study showed that the arch width changes between pre and post orthodontic treatment with extraction in the inter molar width was less than the inter canine width, these findings agreed with Hnat *et al* [16].

Tables (3 and 4) showed, that the range of distance between the labial surface of the central incisors to the incisive papilla of pre orthodontic treatment was 7.07–8.36 mm. for female and male respectively larger than that after orthodontic treatment, these findings were agreed with many authors [17,18]. The segmental linear measurements for the incisal, canine, molars, and anatomical landmarks showed less dimensional changes with extraction rather than without extraction treatment as reported by Isik *et al*, and Hassanali *et al* [11,19].

For the second participants: Figure (1) showed that there was slight decrease in mean differences of the important linear measurements of the two samples of this group that determine the construction of the prosthesis. Figure (2) showed that the size of the selected teeth for artificial prosthesis for the second sample patient with orthodontic treatment asymmetry in the size to mach the natural appearance. These findings insure that the results of this study were agreed with many authors [20,21–25], they reported that more appropriates to use only known hard tissue landmarks in mouth width and length prediction for selection of artificial teeth to construct a prosthesis. Figure (3) showed the results of Prosthodontics finding of clinical cases with previous orthodontic treatment less comfort with prosthesis due to reduction in the length of saddle area and number of artificial teeth as reported by other study [26,27], and disagreed with other study who found that many people are satisfied with prosthesis with less than 28 teeth [28]. Higgins and Lee [25] explained the location of the occlusal centre of the force is important factor for comfortable or successfulness of prosthesis. This force is not affected by the gender or age but the width and lengths of the arch are the significant factor in relation to the occlusal load centres.

Table (1): Mean differences of maxillary arch measurements pre orthodontic treatments

Measurement	Sex	Mean (mm.)	N	Sd	Paired Differences				t	df	Sig. (2-tailed)	Correlation 2-tailed	Sig.
					Mean	Sd	95% Confidence Interval of the Difference						
							Lower	Upper					
C-C Pr	Female	31.8833	24	5.2503	0.6292	5.2249	-1.5771	2.8354	0.590	23	0.561	0.141	0.512
	Male	31.2542	24	1.2680									
M-M1st Pr	Female	38.6667	24	5.4986	0.4917	5.0501	-1.6408	2.6241	0.477	23	0.638	0.442	0.030*
	Male	38.1750	24	1.3430									
M-M2nd Pr	Female	40.8792	24	4.7653	-0.0458	4.5728	-1.9768	1.8851	-0.049	23	0.961	0.298	0.158
	Male	40.9250	24	0.9566									
ICr Pr	Female	18.1525	24	3.1056	-1.0892	3.3303	-2.4954	0.3171	-1.602	23	0.123	-0.008	0.971
	Male	19.2417	24	1.1784									
ICl Pr	Female	18.8208	24	2.6304	-1.1208	2.8902	-2.3412	0.09957	-1.900	23	0.070	-0.049	0.819
	Male	19.9417	24	1.0750									
CMr Pr	Female	20.8292	24	2.9580	-0.1500	2.9243	-1.3848	1.0848	-0.251	23	0.804	0.157	0.464
	Male	20.9792	24	0.5920									
CMl Pr	Female	20.4917	24	3.1253	-0.4333	3.1451	-1.7614	0.8947	0.675	23	0.506	0.101	0.637
	Male	20.9250	24	0.7908									
IMo Pr	Female	36.0292	24	4.2874	-3.5750	4.6068	-5.5203	-1.6297	-3.802	23	0.001**	0.118	0.583
	Male	39.6042	24	2.2648									
Arc-C Pr	Female	54.0133	24	5.5333	-1.9867	6.1244	-4.5728	0.5995	-1.589	23	0.126	-0.260	0.219
	Male	56.0000	24	1.5537									

Pr: Pre treatment; C-C: Inter canines distance; M-M1st: inter 1st molar mesial buccal cusps; M-M2nd: inter 2nd molar mesial buccal cusps; ICr: Incisor to cusp of canine right; ICl: Incisor to cusp of canine left; CMr: Canine to mesial cusp of 2nd molar right; CMl: Canine to mesial cusp of 2nd molar left; IMo: vertical distance from Incisal to line between molars; Arc-C: arc measurement from distal canine to distal canine; N: Number; Sd: Stander deviation; df: degree of freadum; Sig: Significancy.

Table (2): Mean differences of maxillary arch measurements Post orthodontic treatments

Measurement	Sex	Mean (mm.)	N	Sd	Paired Differences				t	df	Sig. (2-tailed)	Correlation 2-tailed	Sig.
					Mean	Sd	95% Confidence Interval of the Difference						
							Lower	Upper					
InCd Po	Female Male	32.9167 33.8083	24 24	2.4140 0.6756	-0.8917	2.5222	-1.9567	0.1734	-1.732	23	0.097	-0.024	0.912
M-M1st Po	Female Male	35.6125 35.7625	24 24	2.7756 1.6450	-0.1500	3.0075	-1.4200	1.1200	-0.244	23	0.809	0.149	0.486
M-M2nd Po	Female Male	39.1875 39.4875	24 24	3.5922 0.8704	-0.3000	3.7867	-1.8990	1.2990	-0.388	23	0.701	-0.108	0.614
ICr Po	Female Male	18.6417 20.2208	24 24	1.9649 0.8531	-1.5792	2.1020	-2.4667	-0.6916	-3.681	23	0.001**	0.051	0.814
ICl Po	Female Male	18.7875 19.2917	24 24	1.3665 0.9550	-0.5042	1.6499	-1.2009	0.1925	-1.497	23	0.148	0.022	0.919
CMr Po	Female Male	15.6958 13.8708	24 24	2.6576 1.6153	1.8250	3.0315	0.5449	3.1051	2.949	23	0.007**	0.056	0.794
CMl Po	Female Male	15.3267 17.2520	24 24	3.0815 2.9916	-2.1983	3.0126	-3.4705	-0.9262	-3.575	23	0.002**	0.508	0.011**
IMo Po	Female Male	31.2521 32.5792	24 24	2.9548 1.4359	-1.3271	3.7228	-2.8991	0.2449	-1.746	23	0.094	-0.361	0.083
Arc-C Po	Female Male	53.8125 55.5292	24 24	4.0269 1.5454	-1.7167	4.3786	-3.5656	0.1322	-1.921	23	0.067	-0.046	0.832

Po: Post treatment; C-C: Inter canines distance; M-M1st : inter 1st molar mesial buccal cusps; M-M2nd: inter 2nd molar mesial buccal cusps; ICr: Incisor to cusp of canine right; ICl: Incisor to cusp of canine left; CMr: Canine to mesial cusp of 2nd molar right; CMl: Canine to mesial cusp of 2nd molar left; IMo: vertical distance from Incisal to line between molars; Arc-C: arc measurement from distal canine to distal canine; N: Number; Sd: Stander deviation; df: degree of freadum; Sig: Significancy.

Table (3): Mean differences of maxillary arch measurements pre orthodontic treatments in relation to some anatomical landmarks

Measurement	Sex	Mean (mm.)	N	Sd	Paired Differences				t	df	Sig. (2-tailed)	Correlation 2-tailed	Sig.
					Mean	Sd	95% Confidence Interval of the Difference						
							Lower	Upper					
LI-P Pr	Female	7.0792	24	1.5997	-1.2875	1.9227	-2.0994	-0.4756	-3.281	23	0.003**	-0.025	0.908
	Male	8.366724	24	1.0273									
P-IC Pr	Female	4.1667	24	1.5511	-0.1667	2.2001	-1.0957	0.7624	-0.371	23	0.714	-0.106	0.620
	Male	4.3333	24	1.4039									
I-M1st r Pr	Female	46.4458	24	5.3977	0.3333	2.9723	-0.9218	1.5884	0.549	23	0.588	0.835	0.000**
	Male	46.1125	24	4.5899									
I-M2nd l Pr	Female	46.0958	24	6.1501	-0.0333	3.1004	-1.3425	1.2759	-0.053	23	0.958	0.864	0.000**
	Male	46.1292	24	5.3339									
C-Hr Pr	Female	39.2542	24	6.5401	1.2250	3.2186	-0.1341	2.5841	1.865	23	0.075	0.884	0.000**
	Male	40.4792	24	6.7828									
C-Hl Pr	Female	38.5583	24	6.4340	1.0750	3.0031	-0.1931	2.3431	1.754	23	0.093	0.894	0.000**
	Male	39.6333	24	6.6122									
H-H Pr	Female	50.7750	24	4.8711	0.3000	2.4383	-0.7296	1.3296	0.603	23	0.553	0.866	0.000**
	Male	50.4750	24	4.2814									

Pr: Pre treatment; LI-P: Labial surface of central incisor to the anterior part of incisive papilla; P-IC: Papilla in relation to inter canine line; I-Mr1, I-Ml1: Incisal to mesial buccal cusp of 1st molar right and left; I-M1st r, I-M2nd l: Incisal to mesial buccal cusp of 2nd molar right and Left; C-Hr, C-Hl: Canine to Hamular notch right and left; H-H: Horizontal distance between hamular to hamular notch; N: Number; Sd: Stander deviation; df: degree of freadum; Sig: Significancy.

Table (4): Mean differences of maxillary arch measurements Post orthodontic treatments in relation to some anatomical landmarks

Measurement	Sex	Mean (mm.)	N	Sd	Paired Differences				t	df	Sig. (2-tailed)	Correlation 2-tailed	Sig.
					Mean	Sd	95% Confidence Interval of the Difference						
							Lower	Upper					
LI-P Po	Female	6.3000	24	1.2389	-0.9583	1.5932	-1.6311	-0.2856	-2.947	23	0.007**	0.027	0.900
	Male	7.2583	24	1.0358									
P-IC Po	Female	4.5833	24	1.3805	-0.0417	1.1602	-0.5316	0.4482	-0.176	23	0.862	0.614	0.001**
	Male	4.6250	24	1.2446									
I-M1st r Po	Female	44.1792	24	3.6813	-0.2458	2.6962	-1.3843	0.8927	-0.447	23	0.659	0.709	0.000**
	Male	44.4250	24	3.3331									
I-M2nd l Po	Female	43.8875	24	4.0454	-0.9500	2.9627	-2.2010	0.3010	-1.571	23	0.130	0.710	0.000**
	Male	44.8375	24	3.6886									
C-Hr Po	Female	37.1125	24	5.8644	1.5250	3.7416	-0.0549	3.1049	1.997	23	0.058	0.816	0.000**
	Male	35.5875	24	6.3708									
C-Hl Po	Female	36.5458	24	5.7305	0.4792	2.0629	-0.3919	1.3503	1.138	23	0.267	0.933	0.000**
	Male	36.0667	24	5.4046									
H-H Po	Female	50.6375	24	4.8121	-0.0583	2.4954	-1.1120	0.9954	-0.115	23	0.910	0.857	0.000**
	Male	50.6958	24	4.3983									

Po: Post treatment; LI-P: Labial surface of central incisor to the anterior part of incisive papilla; P-IC: Papilla in relation to inter canine line; I-Mr1, I-Ml1: Incisal to mesial buccal cusp of 1st molar right and left; I-M1st r, I-M2nd l: Incisal to mesial buccal cusp of 2nd molar right and left; C-Hr, C-Hl: Canine to Hamular notch right and left; H-H: Horizontal distance between hamular to hamular notch; N: Number; Sd: Stander deviation; df: degree of freadum; Sig: Significancy.

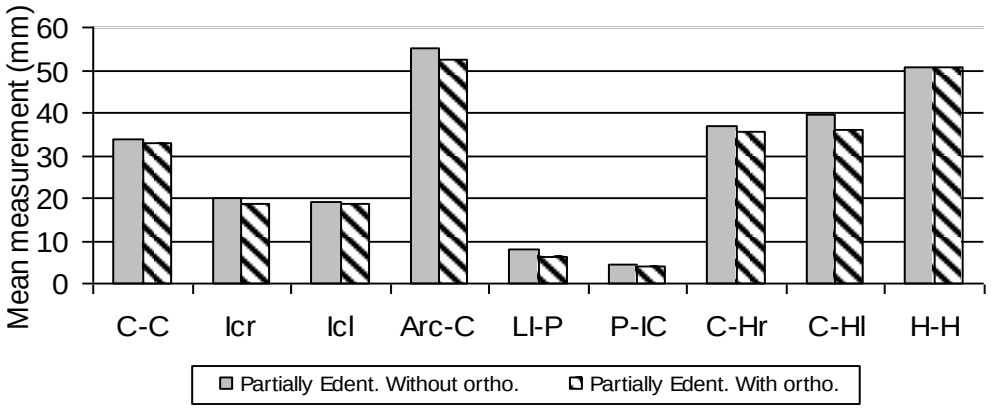

Figure 1: Mean of maxillary arch measurements of partially edentulous patients.

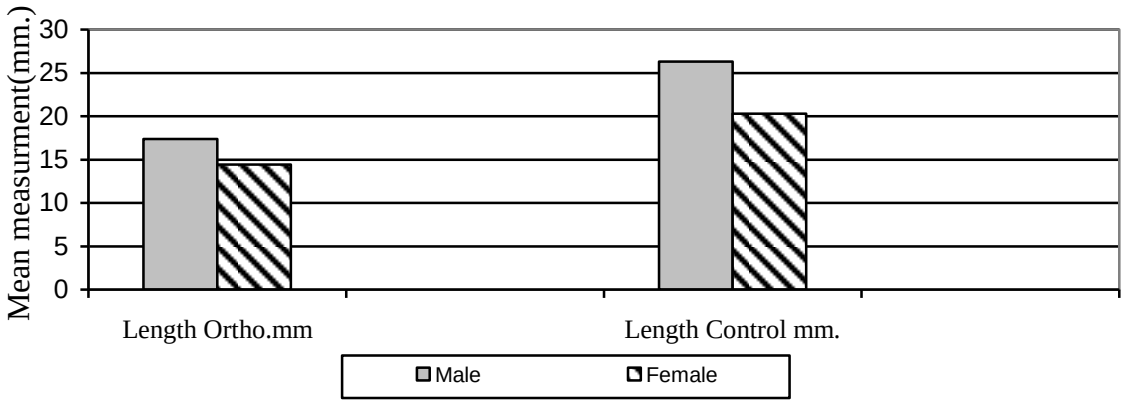

Figure (2) Mean length of free end saddle area of treated prosthodontic clinical cases with or without previous orthodontic treatment.

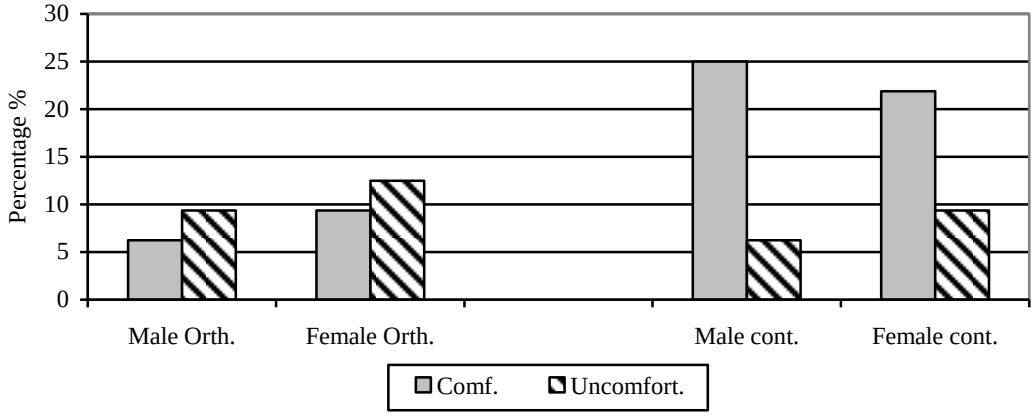

Figure (3): Percentage of comfort and uncomforted of patients with prosthodontic treatment.

CONCLUSIONS

Mean values of the all linear measurements were generally higher in the males compared with females and the significant sex differences in the means *P*> 0.001. The anatomical landmarks and measurement of artificial teeth showed slight mean difference and forward in position in relation to control group. The com-fort percentage and successfulness of Prostho-dontics treatment finding was hig-her in clinical cases without previous orthodontic treatment in relation to the second group.

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