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Evaluation of the Articulation Following Orthodontic Treatment Utilizing Sam II Articulator and T-scan Occlusal Analyser Before and After Occlusal Adjustment

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The aim of orthodontic treatment has been expanded to include the ideal skeletal and functional relationship. This study was conducted on 9 girls and 11 boys (total 20) between 13-15 years of age. The patients were evaluated 6 months after the completion of retention, with the T-Scan occlusal analyser and semi adjustable SAM II articulator, following non extraction treatment with Straight Wire Roth technique. The number and localisation, the sequence and amount of premature contacts were evaluated qualitative and quantitatively in this study. Result indicates there was a significant increase in the number of contacts after occlusal adjustment with both SAM II articulator and T-scan occlusal analyser. However, there was a significant level of difference between the sensitivity of the two methods ($p<0.001$).

Key words: Occlusion, T-Scan, SAM II articulator

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Introduction

The position of the temporomandibular joint during ideal functional occlusion is defined as the bilateral and simultaneous contacts of the teeth, when the joint is in the most superior and posterior position. The functional cups of the mandibular teeth are in maximal intercuspation with maxillary counterparts during centric and habitual occlusion. In this position the palatinal cusps of the mandibular teeth are in simultaneous and maximum contact on both sides of the arch. These relations help in maintaining the occlusal stability in centric occlusion. The destruction of this stability; extrusion of teeth, intrusion, rotations and malpositioned eruptions result in occlusal instability (Okeson, 1989; Beyron, 1959; Mohlin *et al*., 1980).

The aim of orthodontic treatment is achieving desirable esthetics with improved function. Dental arch form and intermaxillary dental relationships are the two important factors that are used in evaluating function in a harmonious stomatognathic system. The evaluation of function at the end of orthodontic treatment, requires assesment of intermaxillary relationship with bilateral contacts (Mohlin *et al*., 1980; Milosevic and Samuels, 2000).

After orthodontic appliances are removed and the teeth are left to settle, the intercuspation between the arches gets healthier and the researches have determined an increase in the number of occlusal contacts during retention period. The reason for this is the life-long eruption and adaptation of teeth.

While the detailed inspection and evaluation of occlusal contacts within the two dental arches is part of a routine orthodontic process, research carried out on this subject is limited (Clark and Evans, 1998). Several qualitative and quantitative methods are used in determining occlusal contacts. Hard and soft biting wax, articulating paper, special spray dyes, silicon impression materials, mouth stone and articulators are considered as qualitative methods, while photo-occlusion and T-Scan occlusal analyser are the quantitative methods in determining occlusal contacts. The T-Scan occlusal analyzer is a computerized tool, developed to address the insufficiencies of previous methods. The T-Scan occlusal analyzer aids in the determination of primary contacts (Sabah and Özpinar, 2001; Woda *et al*., 1979).

In this study occlusal contacts following orthodontic treatment were evaluated both qualitative and quantitatively using T-Scan occlusal analyser and SAM II articulator, in 20 subjects, who have completed their orthodontic treatment, before and after occlusal adjustment.

Materials and Methods

This study was conducted in Faculty of Dentistry, Ege University on a total of 20 patients of which 9 were girls and 11 were boys, between the ages of 13-15 years. The patients had received non-extraction orthodontic treatment. All the subjects were evaluated

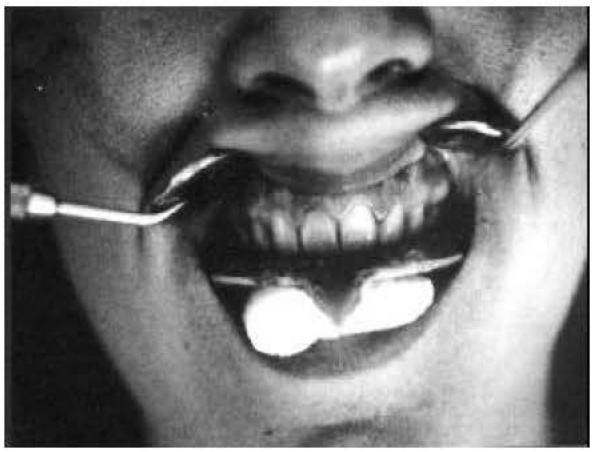

Fig. 1: Placing the bite fork in the mouth

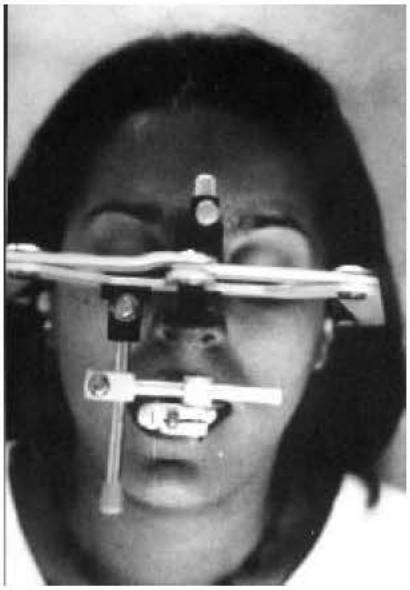

Fig. 2: Application of the facial arch on the patient

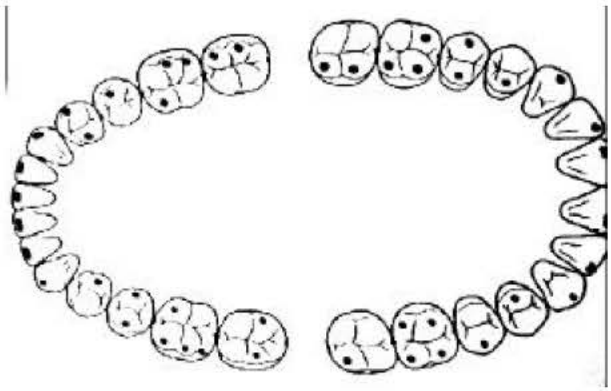

Fig. 3: Recording the contact point

Fig. 4: Disposable sensor

6 months after the completion of the retention period with T-Scan occlusal analyser and semi adjustable SAM II articulator. The patients were subjected to occlusal adjustment following this evaluation. For this procedure, upper and lower casts in the

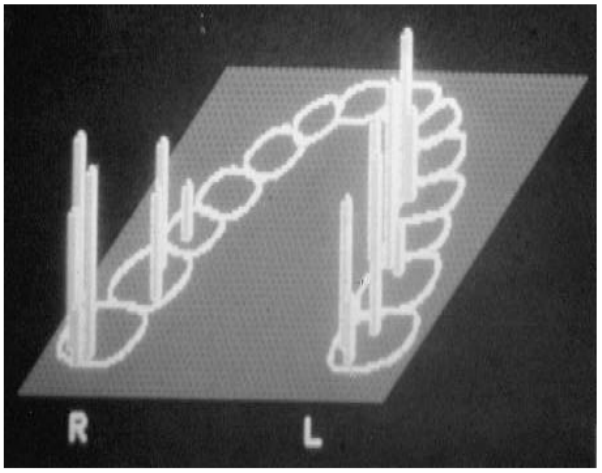

Fig. 5: Contact points on the T-Scan system

maximal intercuspation of the individual, were carried to the articulator before and after occlusal adjustment. The imprints of the maxillary teeth were obtained over the bite fork, the midline of the bite fork being in correspondence with the maxillary midline (Fig. 1). The maxillary position in regard to the cranium has been determined by correct adaptation of the facial arch, ear and nasion rods. This position was carried to the semiadjustable SAM II articulator with the help of stone, with the Bennet angle at 16° and the condylar path angle 33° (Hwang and Behrents, 1996). Investigators have stated that using a facial arch, the occlusal plane relationship with the cranium can be determined reliably (Fig. 2).

For the SAM II, the centric relationship of the patient has been determined using dental wax and has been fixed with the previously determined maxillary position.

The primary contacts during centric relation, lateral and protrusive movements of the models fix on the SAM II articulator, have been determined using different colors of articulating paper (red, blue, yellow) and has been recorded on a separate sheet for each patient (Fig. 3). The points during centric relation, protrusion and lateral jaw movements have been counted and recorded. This procedure and recording was repeated after occlusal adjustment. Following this procedure, the same patient group has been evaluated using the T-Scan occlusal analyser before enamel reduction quantitatively.

The most important element of the T-scan system is the disposable sensor (Fig. 4). The upper and lower surfaces of the sensor are covered with the thin conductive strips which contain 1500 sensitive points. The sensor is placed on a hand piece which is connected to the system and then placed in the mouth. The patient is then, asked to bite tightly, move the lower jaw right, left and forward without losing the occlusion. The contact points in centric relation, lateral and protrusive movements are determined as vertical lines and the height of these lines show the amount of force at that contact point (Fig. 5). These force points have been recorded in the patient file before and after occlusal adjustment on the screen and printed by the computer.

During occlusal adjustment diamond burs have been used and the following points were taken into consideration:

a The adjustment was not a one time procedure, it was repeated 3-4 times
b The crest of the cusps have been preserved, while reduction was done on inclinations
c The points of centric relation have been saved
d The early contact points during centric relation, lateral and protrusive movements, have been stripped in a sequence.
e No enamel reduction was done on the palatinal tubercules of the maxillary and the buccal tubercules of the mandibular teeth which are considered the functional tubercules.
f The contacts on the balancing side during lateral excursions have been reduced.
g Posterior disclusion was created during protrusive movement
h The surfaces of the teeth whose enamel were reduced were polished and fluorised following occlusal adjustment.

Results

There was a significant increase in the number of contacts after occlusal adjustment with both SAM II articulator and T-Scan occlusal analyser (Table 1). However there was a significant level of difference between the sensitivity of the two methods ($p < 0.001$). The number of contacts recorded before and after occlusal adjustment with the T-Scan system is significantly less than that of the number of contacts recorded with the SAM II articulator.

There were no statistically significant differences before and after enamel adjustment in the number of contacts recorded with SAM II and T-Scan occlusal analyser during centric relation and left lateral movement. However the increase in the number of contacts during protrusive and right lateral movements recorded with the SAM II articulator is statistically significant ($p < 0.05$). No statistically significant difference was observed with the T-Scan System, for the protrusion and right lateral movement.

Discussion

Investigators have reported that the occlusal contacts recorded during maximal intercuspitation can be repeated with little method error regardless of the qualitative and quantitative measurement used (Durban and Sadowsky, 1986; Stuart, 1985; Berry and Sing, 1983).

Mc Namara and Henry (1974) have evaluated the occlusal contacts in centric occlusion and centric relation and have determined that, the number of contacts can decrease to 1-2 during centric relation. They have stated a preference over centric relation in longitudinal studies because of repeatability. Berry and Sing (1984) have determined a difference between morning and evening recordings. Riise (1982) has stated that bite force effected the number of occlusal contacts and that with light forces less number of contacts was recorded, therefore the same amount of bite force is to be exerted. This study made recordings in the morning and with light bite forces to minimize method error.

Durban and Sadowsky (1986) have stated an increase in the total number of teeth in contact over time following orthodontic appliance removal and settling of the teeth. The gain in the total number of contacts was mainly due to an increase in the number of contacts on posterior teeth. Gazit and Liberman (1985) have reported greater increase in the number of teeth in contact, using tooth positioners rather than conventional retainers.

In this study occlusal recordings were made 6 months after the cessation of retention with Hawley type appliances, to permit the settling of the teeth.

In a theoretically ideal occlusion, there are two contacts on tips of the cusps when the cusp tip is in contact with two marginal ridges. If the cusp tip in contact, touches only one ridge there will only be one contact. If we extend this principle over the whole dental arch, according to Okeson (1989), in an ideal occlusion there should be 34-48 contacts. While Ricketts (1969) determined 48 contacts, Hellmann states this number as 138.

Mc Namara and Henry (1974) have found a mean of 19. 7 occlusal contacts in boys between 16-17 years following orthodontic treatment.

In a study evaluating, number of occlusal contacts in maximum intercuspation. Haydar (1992) have compared the data after active orthodontic treatment and following 3 months of retention with a control group and have reported significant differences. The investigators used a Hawley type retainer and tooth positioners as retention appliances and have stated that no difference was seen

Table 1: The difference between before and after adjustment contact numbers

	Centric relation				Left lateral movement			
	SAM		T Scan		SAM		T Scan	
	B.A	A.A	B.A	A.A	B.A	A.A	B.A	A.A
Mean ±SD	15.2±9.12	19±11.25	7.1±2.42	92±3.67	4.8±10.03	48±12.37	2.1±1.28	3.8±4.26
Mean Devi.	07.64	10	1.92	3.04	8.12	9	1.12	3.32
Minimum	3	5	4	6	30	23	1	1
Maximum	31	33	10	17	61	62	4	5
	Right lateral movement				Protrusion movement			
	SAM*		T Scan		SAM**		T Scan	
	B.A	A.A	B.A	A.A	B.A	A.A	B.A	A.A
Mean ±SD	37.2±8.77	46.5±10.04	2.6±1.57	2.7±3.05	14.1±8.71	37.8±13.78	2.8±1.39	1.8±0.42
Mean Devi.	6.8	8.8	1.4	0.84	5.14	11.84	1.08	0.32
Minimum	24	34	1	1	6	17	1	1
Maximum	46	61	5	3	37	45	5	2

B.A:Before adjustment A.A: After adjustment *: $p<0.05$ **: $p<0.01$ Mean Devi.: Mean Deviation

in the number of contacts regarding the two different types of appliances.

This study conducted on 20 patients, using T-Scan occlusal analyser and SAM II articulator has determined the number of contacts following occlusal adjustment in centric relation as 33. There has been 35% increase in the number of contacts following occlusal adjustment and the reliability of the SAM II articulator.

The aim of orthodontic treatment has been broadened include static and dynamic maxillomandibular relationship. Evaluation of occlusal contacts among dental arches is a routine part of orthodontic procedures. For a stable and functional result, occlusal contacts have to be checked at the end of orthodontic treatment. Occlusal adjustment following orthodontic treatment, results in an increased number of contacts and is important for the stability of the orthodontic result

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