Analysis of Mandibular Movement after insertion of Fixed Partial Dentures using Cadiax Compact II®

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Key words
Mandibular movement, Horizontal condylar inclination angle, Bennette angle, Cadiax Compact II®
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Abstract

The aim of this clinical study was to analysis the mandibular movement in patients after insertion of fixed partial dentures using Cadiax Compact II and compares the Horizontal condylar angles and Bennette angles before and after insertion of posterior fixed partial denture.

Material and methods: Mandibular movement of thirty two patients, sixteen males and sixteen female planed for posterior fixed partial dentures), had been recorded using Cadiax Compact II® for Horizontal Condylar Inclination and Bennette Angle. Three records had been obtained R1 before the abutments teeth preparations of the Fixed Partial Dentures, R2 after the cementation of the Fixed Partial Dentures and R3 after one month of the Fixed Partial Dentures cementation.

Results: Statistical highly significant difference was found between R1&R2 for Bennette angles in both males and females, and significant difference in group R1&R3 for Horizontal condylar Inclination in females only. The other groups show no statistical significant difference.

Conclusion: Within the limit of this clinical study, the insertion of fixed partial denture have no changing effect on the Horizontal Condylar inclination in males but in females have mild change. For Bennette angle there is highly significant change in both males and females immediately after the fixed partial denture cementation, but after one month this change disappeared.

Introduction

Tooth loss is mainly associated with elderly people, as a consequence of biomorphotic changes and body aging, yet it may also result from compromised hygiene, systemic diseases or harmful addictions. In the long term, the absence of a particular tooth may lead change of mandibular dynamic pattern, as well as disrupt the correct relations within the Tempro Mandibular Joint (1).

Occlusion is of fundamental importance in restorative dentistry, as all restorations placed in the mouth can have a profound effect on it, from simple intracoronal restorations to complex fixed partial denture (2).

The main goal of restorative dentistry is to truly capture maxillo – mandibular relationships that accurately reproduce mandibular border movements and that would prescribe the best occlusal interface (3).

The characteristic of mandibular movement are established by the morphology of the Tempro Mandibular Joints as a posterior determinant, and by the relationship of the anterior teeth as an anterior determinant (4).

Mandibular Movement is a critical step in making the functional occlusal morphology and improving the diagnosis

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and treatment of tempro mandibular joint disorder (4, 5).

Registration of horizontal and sagittal movements of the patient allows maximum cusp height and fossae depth with proper placement of occlusal ridges and grooves. The goal is to develop an occlusion that is interference free and entails the concepts of organic occlusion. Methods to transfer patient information to a highly adjustable articulator include mechanical recorders, mechano - electronic recorders and optoelectronic recorders (5).

In review to the clinical problems, during construction of fixed prosthodontics great attention should be spend to achieve an accurate occlusal relationship, copy mandibular movement of the patient in the laboratory and organize the occlusion. In designing occlusal surfaces, the taller cusps allow for masticatory efficiency, have better esthetics, stabilize the tooth and stabilize the arch. The shorter cusps decrease the risk of occlusal interferences. The disadvantage to taller cusps is an increased risk of interferences during mandibular movement. The disadvantages to shorter cusps are the opposite of the advantages of tall cusps (3, 6, and 7).

The medial wall of the temporal fossa and the tightness of the inner horizontal portion of the TMJ ligament attached to the rotating condyle, which determine the amount of Bennette movement, will dictate whether the cusp tips may be longer or must be shorter, and whether the placement of the cusp pathways (the grooves) will be more mesial or more distal. The angle of the emenetia influences the cusp height and shape of the lingual concavity of maxillary anterior teeth (1, 8). The closer a tooth is to the condyle (more posterior), the more the tooth is influenced by the control of posterior determinant (tempromandibular joint) (9).Aull (1965) demonstrated that large changes in the condylar guide assembly resulted in dramatic changes in cusp height and cusp paths (10).

When determining the Horizontal condylar path inclinations (in sagittal plane) using clinical procedures, the anterior check bite method is preferred as the usual method for reproducing them in a semi-adjustable articulator. However, it has often been suggested that the sagittal condylar path inclinations obtained by this method are unstable (11).

Numerous approaches have been reported to record mandibular movement (5, 12). For many years the prosthodontists used inter occlusal wax records for condylar guidance setting. The mechanical condylograph (axiograph) was introduced by Slavvicek (13), it's supported to improve and simplify the recording of condylar path by tracing precisely the translation of the condyle (14).

In 1999 Gamma GmbH, Kolesterneuberg, Austria was introduce the Cadiax Compact II®, as a computerized axiography for electronic registration of mandibular movements (15).

Cadiax Compact II can be considered as an accurate and reliable device for recording condylar inclinations and relative anatomy of the condylar guidance in clinical practice and for research purposes (14, 15, 16, 17).

The aim of this clinical study is to analysis the mandibular movement after insertion of fixed partial dentures using Cadiax Compact II® and compares the Horizontal condylar angles and Bennette angles before and after insertion of posterior fixed partial denture.

Material and Methods

Subjects

Population sample of this research was selected from the patients attending the dental clinic in conservative department, teaching hospital Almustansiria university. The sample was constitutes of thirty two patients, sixteen females and sixteen males, all of them seeking for fixed partial denture to replace missing teeth, the patients selected according to the following criteria:

1- Patients aged 25 – 60, diagnosed with unilateral partial edentulism.

2- Absence of substantial dental or periodontal disease.

3- Free of any signs and symptom of tempromandibular joint dysfunction as described by Helkimo (18).

4- Avoid any medications such as analgesic or muscle relaxants during the whole experimental period.

5- Patients with normal Class I occlusion (both canine and molar relation) according to Angl's classification.

Methods

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The main stages of the study consisted in registering the condylar path by means of a Cadiax Compact II® device (Gamma Dental, Austria). It's an electronic axiography, comprises an upper and a lower face bow, registration plates and telescopic markers .

Start up the Cadiax Compact II® software on the PC and connect the Cadiax Compact II to the computer. Next, enter the patient data, there are input field available above the coordinates system, for given name, family name, date of birth and gender. Cadiax Compact II® enables a three dimensional registration of the movement arbitrary hinge axis (as well as point it marks on the articular condyle), with a special module connects the set to a personal computer, which make it possible to have condylar tracks plotted on the screen in real time .

Then we start to fix the upper face bow (depending Frankfort Plane), the lower face bow mounted to the lower arch using a paraocclusal clutch rather than a standard tray (to avoid making an artificial surface which could disturb eccentric occlusal movement. It's essential to make sure that the arms of the upper and lower face bow are in parallel manner (19(

The registration was started from the reference point (the point to which the patient was brought to it with unforced chin point guidance), the coordinates of this position were recorded (20). Excursive movements were made from this reference position. All movements were carried out three times. The (5 mm) pathway was used to determine the length of the axiographic pathways, which had been stored in the computer, then measured electronically. The distance is (the length of the chord from the coordinate starting point, which corresponds to the reference position, to the chosen point) was measured in mm. The chord of the TMJ pathway was measured because, unlike the condylar pathway which is marked by variably strong distortions due to muscle trembling and clicking phenomena, it corresponds to the objectively determinable, morphological – functional condylar movement.

The patient asked to carry out the movements three times in the following sequence; protrusion\ retrusion movement, right mediotrusion, left mediotrusion and maximum opening\ closing movements from, the reference position to the maximum range (21, 22).

Grouping;

Three groups of readings had been obtained Horizontal condylar inclination in sagittal plane (Horizontal Condylar Inclination HCI) and Bennette Angle (BA) in mediotrusive movement as follow:

(R1) the readings which had been obtained before the abutments teeth preparations of the Fixed Partial Dentures.

(R2) the readings which had been obtained after the cementation of the Fixed Partial Dentures.

(R3) the readings which had been obtained after one month of the Fixed Partial Dentures cementation.

All the fixed partial dentures were porcelain fused to metal which had been checked three times, firstly as metal check for adaptation, then, after porcelain build up before glaze, for occlusal adjustment to eliminate any occlusal interferences (centric, protrusive, working and non working interferences), and lastly after glaze before cementation.

Data collection and: Statistical analysis:

1- Descriptive statistics: Mean, Standard deviation, Standard Error Minimum and Maximum values and Bar charts.

2- Inferential statistic: analysis of variance (t- test) was performed to evaluate significant differences between data collected by Cadiax Compact II® within level of significance (p value < 0.05)of the data was made by using Statistical Package for the Social Science (SPSS ver.13 Inc., Chicago, IL).

3-Results:

The recorded data of the sagittal condylar inclination, and Bennette angles were presented in table (1), table (2) and table (3).

Table (1) represents the means of Horizontal condylar inclinations (43.625) and Bennette angles (16.80) for males. For females the means of Horizontal condylar inclinations (35.406) and Bennette angles (16.0125), before preparation of the abutment for fixed partial denture construction, with their standard error and standard deviations. This is clearly showed in fig. (1).

The highest mean of Horizontal condylar inclinations was (62) and the lowest mean was (32) among males, while for Bennette angle the highest value was (18.30) and the lowest value was (15.00). For females the highest mean of Horizontal condylar inclinations was (51.50) and the lowest mean was (18.00) among females, while for Bennette angle the highest value was (18.10) and the lowest value was (13.00).

Table (2) represents the data that had been obtained after the cementation of the fixed partial dentures for both males and females with their descriptive statistic. While table (3) represent the data that had been obtained after one month of the cementation of the fixed partial dentures for both males and females with their descriptive statistic.

ANOVA test revealed a significant difference among groups. In both HCI subgroups and B.A. subgroups table (4) and table (5).

Student t –test was used to investigate the source of difference, which had revealed no significant difference between R1 & R2, and R2 & R3, while significant difference between R1 & R3 in Female SCI. as shown in table (6), which also show no significant difference between R1 & R2, and R2 & R3, while high significant difference exist between R1 & R3 in Female B.A.

In Male HCI Student t–test showed, no significant difference existence between all subgroups (R1 & R2), (R2& R3) and (R1&R3). For Male B.A only (R1 & R2) show high significant difference, the other subgroups (R1 & R3) and (R2 & R3) had no high significant differences.

4-Discussion

Clinical goals of restorative dentistry include achieving an accurate occlusal relationship, simulating mandibular movement of patients in the laboratory and organizing occlusions (15),

Cadiax Compact II® device can be used as an accurate and reliable instrument for recording condylar inclinations and relative anatomy of the condylar guidance in clinical practice and research purposes (6, 13, 14).

The Horizontal condylar inclination in sagittal plane was recorded at 5 mm. of condylar truck from occlusal contact position, so the record had express more closely the immediate and progressive shift of the patient and at this distance of condylar truck there is no contact between the teeth so all movements can be done without any interferences in occlusion which can be different from patient to another (1, 13).

Bennette movement is a bodily side shift of the mandible that occurs in lateral excursive movement. The total Bennette movement of two parts immediate side shift (ISS) and progressive side shift (PSS). During lateral excursion the orbiting condyle moves down ward, fore ward and inward in the mandibular fossa around axis located in the opposite (rotating) condyle(1).

All the fixed partial Dentures involved in this study were posterior and extended distal to the canine, which mainly influenced by the posterior determinant of the mandibular movement (TMJ) more than the incisal guidance (anterior determinant), to clarify their effect on the mandibular movement.

1- The Horizontal Condylar Incli nation angles HCI (in sagittal plane):

Concerning the Horizontal Condylar Inclination angles HCI in relation to the time of recording in female, the mean SCI angles are (R1– 35.406°) which is before the abutment teeth preparation of the FPD, (R2–36.8125°) the record after the cementation of the FPD, and (R3–36.430°) which is the record after one month of the FPD cementation.

There are no significant differences between R1&R2, and between R2 & R3, which mean no significant change in the HCI angle after insertion of the FPD under the circumstances of this study, the fabrication of the FPD and the occlusal adjustment had been achieved by proper and scientific steps (14).

Only significant differences exist between R1&R3, and that could be explained as the long term loss or absence of a particular tooth may lead to a modification of the nerve – muscle tension and change of the mandibular dynamic pattern, as well as disrupt the correct relation with the Tempro-Mandibular Joint (1).

In male groups the mean of HCI angles are (R1– 43.3438°) which is before the abutment teeth preparation of the FPD, (R2– 44.00°) the record after the cementation of the FPD, and (R3–44.437°) which is the record after one month of the FPD cementation.

These results show no significant differences among all groups, which indicate that there is no real change in the protrusive mandibular movement pattern. The same result had been obtained by Al-s'sadi 2010, that may be due to the fact that the recording of the Horizontal condylar inclination angle occurs in anterio – posterior mandibular movement and the angle formed by the path of the condyle, (within the horizontal plane compared with the median plane) typically is curved with its steepest inclination near the centric relation. After that the condyle guided by the anatomy of superior and anterior walls of the glenoid fossa under neuro – muscular control with no influence of the posterior teeth cusp tips (4, 16). In the same time it is possible for the stomatognathic system to adapt itself especially with mild change or restricted edentulism (20).

2- Bennette Angle:

The Bennette path (which guided by Bennette angle) influence the position of the cusps in there mesiodistal relation to each other on the working side. On the balancing side the Bennette path influences the height of the cusps as well as their position. That brings the importance to record the path of the Bennette movement and arrange the cusps of the teeth so that they can pass each other without clashing or climbing upon each other during function. At the same time, a continuous contact of these surfaces should be maintained in order

they can efficiently perform their function of chewing without damage to the supporting structures (23, 24).

The results in this study revealed a high significant differences between R1 & R2 for both Female and Male groups and no significant differences between R2 &R3 and between R1& R3 also for both Female and Male groups. This finding could be explained as that the Bennette movement is very critical because there is a continuous contact of the occlusal surfaces particularly during immediate side shift. Thus a laterosuperior movement of the rotating condyle will require shorter posterior cusps than will a straight lateral movement; likewise, lateroinferior movement will permit longer posterior cusp than will a straight lateral movement(1). Thus after the insertion of the FPD absolutely there is some kind of effect or even change in the Bennette movement and as a consequence immediate change in the Bennette angle, unless the cusp tips posterior FPD are out of contact.

The non significant differences between the readings after FPD insertion with the reading after one month for both Female and Male groups could be explained depend on the anatomical fact that, the amount of Bennette movement is determined by the tightness of the inner horizontal portion of the TM ligament attached to the rotating condyle as well as the degree to which the medial wall of the mandibular fossa departs from the medial pole of the orbiting condyle, so when a mild change occur, it could be overcome by adaptive occlusion otherwise it will persist as an occlusal interferences.

enclosed within the material , and hence exhibited good adaptation to dentinal walls. Only Critique of carrier based obturation is the possibility of the plastic carrier being stripped of gutta-percha, especially in the apical third allowing the carrier to be in direct contact with the canal walls. Jarrett et al found that root canals filled with thermafil revealed the carrier directly against the wall of the canals[24].

Conclusion

Within the limit of this clinical study, the insertion of fixed partial denture have no changing effect on the Horizontal Condylar inclination in males but in females have mild change. For Bennette angle there is highly significant change in both males and females immediately after the fixed partial denture cementation, but after one month this change disappeared.

Table (1): Descriptive statistic of the HCI and BA in degree before the abutments preparation for both males and females.

Group of mean	N	Min.	Max.	Mean	Std. Error.	S. D.
(R1) HCI male	16	62	32	43.3438	2.05736	8.22946
(R1) B.A. male		15.00	18.30	16.800	0.21331	0.85323
(R1) HCI, female	16	51.5	18	35.406	2.32702	9.30809
(R1) B.A, female		13.50	18.10	16.0125	0.31949	1.27795
Total	32					

Table (2): Descriptive statistic of the HCI and BA (in degree) after the cementation of the fixed partial dentures for both males and females.

Group of mean	N	Min.	Max.	Mean	Std. Error.	S. D.
HCI male	16	31	61.5	44.0	2.23234	8.92935
B.A. male		15.5	18.20	16.875	0.22684	0.90738
HCI, female	16	18	52.5	36.8125	2.46766	9.87062
B.A, female		13.5	18.2	15.8188	0.34535	1.38141
Total	32					

Table (3): Descriptive statistic of the HCI and BA (in degree) after one month of the fixed partial dentures cementation for both males and females.

Group of mean	N	Min.	Max.	Mean	Std. Error.	S. D.
HCI male	16	34	64	44.437	8.76522	2.19131
B.A. male		15.80	18.00	17.053	0.71191	0.17798
HCI, female	16	55.5	18	36.430	9.30809	2.32702
B.A, female		13.00	18.00	16.134	1.40389	0.35097
Total	32					

Table (4): ANOVA test for HCI in both Females and Males.

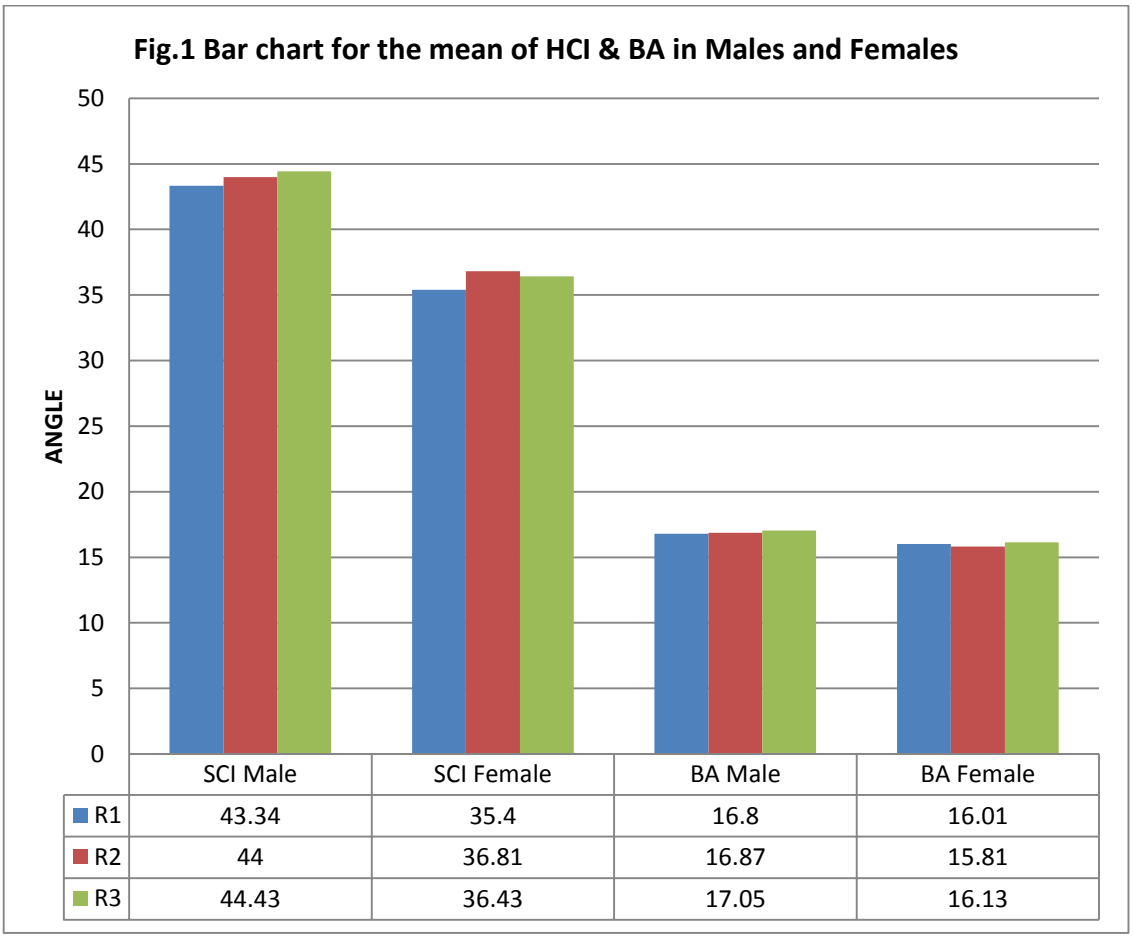
Gender	Source of variation	Sum of Square	DF	Mean Square	F	Sig.
HCI R2 Females	*Between Groups*	1265.813	13	97.370	0.995	0.607
	Within Groups	195.625	2	97.813		
	Total	1461.438	15			
HCI R3 Females	*Between Groups*	1688.938	13	129.918	519.67	0.002
	Within Groups	0.500	2	0.250		
	Total	1689.438	15			
HCI R2 Males	*Between Groups*	1195.500	13	85.393	170.78	0.060
	Within Groups	0.500	2	0.500		
	Total	1196.000	15			
HCI R3 Males	*Between Groups*	1127.938	13	80.567	3.288	0.410
	Within Groups	24.500	2	24.500		
	Total	1152.438	15			

Table (5): ANOVA test for Bennette Angle (BA) in both Females and Males.

Gender	Source of variation	Sum of Square	DF	Mean Square	F	Sig.
BA R2 Females	*Between Groups*	28.359	13	2.181	16.464	0.059
	Within Groups	0.265	2	0.133		
	Total	28.624	15			
BA R3 Females	*Between Groups*	29.314	13	2.255	18.039	0.050
	Within Groups	0.250	2	0.125		
	Total	29.564	15			
BA R2 Males	*Between Groups*	11.608	13	1.161	7.826	0.017
	Within Groups	0.742	2	0.148		
	Total	12.350	15			
BA R3 Males	*Between Groups*	1127.938	13	112.519	3.226	0.104
	Within Groups	24.500	2	34.883		
	Total	1152.438	15			

Table (6): Student t- test between groups of HCI and BA for both Females and males.

Gender	*Angle*	Groups	t – test	P–Value	Sig.
Females	*HCI*	R1 & R2	-0.444	0.663	NS
		R2 & R3	-0.129	0.899	NS
		R1 & R3	-5.039	0.010	S
	BA	R1 & R2	8.671	0.000	HS
		R2 & R3	1.530	0.147	NS
		R1 & R3	-0.436	0.669	NS
Males	*HCI*	R1 & R2	-0.658	0.521	NS
		R2 & R3	0.909	0.377	NS
		R1 & R3	0.534	0.601	NS
	BA	R1 & R2	-8.126	0.000	HS
		R2 & R3	-0.505	0.621	NS
		R1 & R3	0.671	0.512	NS



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