



The Effect of Hinge Axis Position on Mandibular Movements

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ABSTRACT

The objective of this study was to evaluate the effect of an arbitrary and true hinge axis on the Bennett shift and the horizontal condylar path inclination. Ten completely edentulous subjects were selected for this study. For each subject, true and arbitrary hinge axis positions were located. Whip Mix Quick Set Recorder was used to measure the Bennett shift and the horizontal condylar path inclination. The Bennett shift and condylar path inclinations were recorded two times, first using the arbitrary and secondary using the kinematic hinge axis as the starting point for recording. The result of this study showed that there were no statistical differences between the two measures of the Bennett shift and horizontal condylar path inclination.

INTRODUCTION

The primary objective of rehabilitating occlusion is to improve stomatognathic function in patients experiencing dysfunction in mastication, speech, and swallowing as a consequence of tooth loss. The procedure of occlusal treatment involves improving the morphology and the stomatognathic function ⁽¹⁾.

Errors of horizontal condylar inclinations and Bennett angles had largely affected the articulation of teeth and the pathways of cusps. The aim of this study was to estimate and compare between the horizontal condylar (protrusive) angles and Bennett angles of full mouth rehabilitation patients using two different articulator systems. Who concluded that A full adjustable articulator that can provide precision estimation of the horizontal condylar angles and Bennett angles would be most helpful in treating full mouth rehabilitation cases⁽²⁾.

KEYWORDS

Hinge axis

Mandibular movements

The optional articulator capabilities for fabrication of complete dentures would be an adjustable intercondylar distance and an

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immediate Bennett adjustment. The immediate Bennett adjustment primarily influences the width of the central grooves of the posterior teeth, whereas the intercondylar distance influences the character and inclinations of the grooves and cusps⁽¹⁾.

The angulation of cuspal inclines on posterior teeth is affected by the angle of horizontal condylar inclination. The finished complete denture may have occlusal interference during excursive movements, if the condylar guidance of an articulator is set at an angle steeper than that which exists on a patient. The finished complete denture will have more clearance during excursive movement than planned, if the articulator has inclined less steeper than on the patient. An error of this nature has no effect clinically when disclusion exists. The error may have clinical significance when group function or balanced articulation is desired⁽²⁾.

The length of the horizontal condylar path produced by different starting points was compared. There was no significant difference between the true and arbitrary hinge axis on the length and inclination of the horizontal condylar path inclination⁽³⁵⁾.

The lateral border movement of the mandible rarely occurs during function. However, the recording of this mandibular movement is important to set the orientation of the medial wall of the articulator's fossa relative to the midline (Bennett angle). This angle is used to adjust the Bennett shift on the semiadjustable articulator⁽⁶⁾.

The immediate Bennett shift adjustment on semiadjustable articulators can be set by measurement of pantographic tracings, interocclusal wax records, or direct measurement. Interocclusal wax records have been shown to underestimate the immediate Bennett shift. Pantographic tracings are time consuming and more appropriate for fully adjustable articulators⁽⁷⁾.

Recently, a simple device that measures Bennett shift near the skin over the nonworking condyle (Whip-Mix Quick Set Recorder) has been introduced.

The purpose of this study is to assess the accuracy of the arbitrary hinge axis position in relation to the kinematic hinge axis position and to assess the effect of this error on the measurement of immediate Bennett shift and the horizontal condylar path inclination.

MATERIAL AND METHODS

Ten completely edentulous patients between 50 to 60 years age were selected on the basis that they agreed to participate in the study and did not exhibit signs or symptoms of temporomandibular disorders.

The kinematic hinge axis location

Almore hinge axis locator was used to locate the position of the true hinge axis (Almore international Inc. Portland, Oregon, U S A). The hinge axis locator was prepared by attaching the side arm to the end of the anterior cross-bar, and the steel needle was located in position at the end of the side arm. A card was attached by adhesive tape at the preauricular region in both sides of the patient's face. The underside of the bite fork was attached to the lower record block and both record block and bite fork were fixed to the mandible by mandibular clamp. The anterior cross-bar was placed horizontally by attaching the locking clamp to the stem of the bite fork. The locator was positioned so that the steel needle approximates the condyle on the right side, and was locked solidly in this position to the stem of the bite fork. The needle was never allowed to touch the card. The patient was guided to perform opening and closing movement (not more than 20 mm) in the terminal hinge position, while the operator's thumb and index fingers were on the patient's chin. Adjustments of the needle were continued until rotation of the needle was observed. This still point was considered as the hinge axis and was marked with sharp pencil on the card.

The reference plane

The orbitale was palpated and a point opposite to it was marked on the patient's face. The axis-orbitale plane was then extended and drawn on the

card of the hinge axis in both sides using a flexible ruler. Quick Set Recorder (Whip Mix Corp. USA) was used to measure the amount of immediate Bennett shift and tracing the protrusive path way.

Recording of immediate side shift

The flag holder frame of the Whip Mix Quick Set Recorder was adjusted in width to allow positioning of each flag as close as possible to the patient's head.

The bite fork of the quick set recorder was attached to the lower record block. The record block and fork were inserted into the patient's mouth and fixed to the mandible by mandibular clamp

The left and right pointers were oriented over the hinge axis mark on the card. The patient's jaw was guided into the most retruded position, and then the toggle assembly was tightened. The patient was asked to protrude, and then retrace the jaw several times to verify that the points were staying in contact with the plastic flags and that the points were returning to the hinge axis mark.

The horizontal scribed lines on the flags were adjusted parallel to the reference line (axis-orbitale line) drawn on the card attached to the patient's face.

A piece of recording paper was attached to each flag. The paper was aligned with the posterior edge of the flag.

The patient was seated in an upright, comfortable position with the jaw in the most retruded position.

The left and right pointers were locked at the "zero" position on the pointer assembly millimeter scale. The left and right pointer assemblies were slid medially until the points touch the recording paper, then the pointer holding screws were tightened.

The patient was instructed to move his jaw from the most retruded position to the right side to record the immediate side shift of the left condyle. Firm guidance was provided by the operator with a medially directed force on the angle of the mandible

on the left side. The patient was asked to move his jaw slowly towards right shoulder, until the pointers were moved anteriorly 2-3 mm. The amount of immediate side shift was indicated on the pointer assembly scale.

Similarly, the patient's jaw was moved to the left side to record the immediate side shift of the right condyle.

Recording the protrusive condylar path

The patient's jaw was guided into the most retruded position, and then the left and right point locking screws were loosened to allow the leads to contact the graph paper.

The patient was instructed to protrude the mandible (maximum protrusion) to trace the condylar paths on the recording cards.

The recording papers were replaced two times and the protrusive movement was repeated each time to produce three graphical recordings of the sagittal condylar path on each side. The horizontal condylar path angle was measured with a method described by (El-Gheriani and Winstamey 1987⁽⁸⁾).

The arbitrary hinge axis position was located and marked with a method described by (Brandrup-Wognsten)⁽⁹⁾ as instructed by the Quick Set Recorder manufactures. On a line extending from the tragus to the lateral angle of the eye, a point was marked at about 12 mm in front of the posterior margin of the most prominent point of the tragus. The horizontal condylar path was traced on the graphic paper and immediate Bennett shift was measured again with the arbitrary hinge axis was used as the starting point fig (1).

The results of this study were analyzed statistically. The mean, standard deviations and paired T- test were calculated to assess the effect of arbitrary and true hinge axis on the Bennett shift and the horizontal condylar path inclination measurements



Fig. (1) Graphic recording of protrusive pathway.

RESULTS

Effect of hinge axis position on the horizontal condylar path inclination and the Bennett shift measurements was evaluated by determining

the mean value of the horizontal condylar path inclination and the Bennett shift measurements with the arbitrary and true hinge axis points.

Table 1 and 2 summarizes the results of the study.

The result showed that 40 % of the arbitrary axes were located within a 5 mm radius of the true hinge axis. While 80% were located within a 7 mm radius of the true hinge axis.

The measurements of the Bennett shift were ranged from 0.75 to 2.0mm with an average of 1.3mm.

There was no statistically significant difference on the Bennett shift and horizontal condylar path angle measurements when using the hinge axis and arbitrary hinge axis position as a starting point.

Table (1) Horizontal condylar path angles measurements when using different condylar position.

	RIGHT SIDE			LEFT SIDE		
	Mean±SD.	Paired t- value	P value	Mean±SD.	Paired t- value	P value
KINEMATIC HINGE AXIS	35±2.8	1.24	Ns	36 ±2.7	1.4	Ns
ARBITRARY HINGE AXIS	36±2.6	1.60	Ns	35±2.5	1.60	Ns

H CA: - horizontal condylar path inclination. Ns. Non significant

Table (2) Bennett shift measurements when using different condylar position.

	RIGHT SIDE			LEFT SIDE		
	Mean±SD.	Paired t- value	P value	Mean±SD.	Paired t- value	P value
KINEMATIC HINGE AXIS	1.27±0.36	1.12	Ns	1.30±0.22	1.21	Ns
ARBITRARY HINGE AXIS	2±1.95	1.2	Ns	1.32 ±0.23	1.32	Ns

BS: - Bennett shift.

DISCUSSION

With the experienced operators more than 95% of axis locations were within an area of 0.2 mm. The accuracy of hinge axis location and he found an error up to an area 2-4mm in diameter ⁽¹⁰⁻¹¹⁾.

46 % of the arbitrary axis (12 mm in front of the posterior margin of the most prominent point of the tragus) were within a 5 mm radius of the true hinge axis. This comes in agree with the present study ⁽¹²⁾.

The result of the present study showed that there was no statistically significant difference on the Bennett shift measurements when using the hinge axis and arbitrary hinge axis position as a starting point. This comes in agree with **(Lundeen and Mendoza)** who stated that “the difference between the hinge axis and arbitrary hinge axis positions did not have any significant difference on Bennett shift measurements” ⁽⁷⁾.

The average measurement of the Bennett shift in the present study was 1.3mm. This mean was slightly larger than that of **(Lundeen and Mendoza 1984)** ⁽⁷⁾ who measured the immediate Bennett shift on subjects between 20 to 32 years. This comes in agreement with **(Lundeen et al 1978)** ⁽¹³⁾ who found that the average immediate Bennett shift increased with age.

The difference between the hinge axis and arbitrary hinge axis position did not have any significant difference on the horizontal condylar inclination measurements ⁽⁴⁻⁵⁾.

Some authors found coincidence for the initial 5 mm of path length of all condylar paths during protrusive movement in 39 of the studied 44 subjects ⁽³⁾.

CONCLUSION

The arbitrary hinge axis could be used as a starting point for recording the Bennett shift and condylar path inclination with accuracy.

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