

## A COMPARATIVE STUDY OF FACEBOW TRANSFER ON HANAU AND WHIP-MIX ARTICULATORS

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يستعمل القوس الوجهي لتسجيل العلاقة الأمامية الخلفية والعلاقة العمودية للفك العلوي نسبة لمركز دوران المفصل الفكي الصدغي ولنقل هذه العلاقة إلى مركز دوران المطبق .  
من الناحية السريرية فإن القوس الوجهي الأذني لمطبق هانو ١٥٩-٤ ، الذي صمم للاستعمال مع مطبق هانو ١٥٨-٢ ، ولتأمين العلاقة بين الفك العلوي ومستوى فرانكفورت باستعمال مجرى الأذن الخارجية والجوف الحجاجي كنقاط دلالة . وعندما تنقل إلى المطبق القطعة الأذنية للقوس الوجهي تثبت على النتوء الأذني في المطبق ونهاية قضيب الحجاج المتصل بالقوس الوجهي يحرك حتى يلامس الوجه السفلي للصفحة الحجاجية للمطبق والتي تقع على ارتفاع ٧ ملم من مستوى مركز اللقمة للمطبق .  
هذا الوضع يسمح بتحديد العلاقة العمودية للمثال العلوي مع الزراع العلوي للمطبق وبنفس العلاقة التي ينتسب فيها الفك العلوي لمستوى فرانكفورت . وبهذا فإن الميل السهمي لمستوى الأطباق ، عندما ينظر له على المطبق ، سوف يكون مشابها لما هو عليه عند المريض وهو جالس بوضع عمودي وينظر أفقيا . وقد تمت المقارنة بين القوس الوجهي لمطبق هانو والقوس الوجهي لمطبق الويب ميكس . ونتيجة المقارنة والدراسة وجد أن الميل السهمي لمستوى الأطباق على مطبق الويب ميكس أكبر بكثير مما هو عليه في مطبق هانو ١٥٨-٢ ، عندما استعمل القوس الوجهي ١٥٩-٤ لنقل العلاقة والقوس الوجهي للويب ميكس . ووجد أيضا أن مستوى فرانكفورت (المستوى الأظليقي) للفك العلوي الموجود لدى المريض لم ينقل لمطبق الويب ميكس بنفس الدقة كما هو الحال في مطبق هانو ١٥٨-٢ .

Prior face-bow studies showed that the relationship of the plane of reference is not maintained as it is transferred from the patient to the articulator because the anterior third point of reference is not represented correctly on the articulators. The third point of reference which is orbital on the Hanau H2 articulator is located 7 mm above the condylar axis while that on the whip-mix articulator is at the level of the condylar axis.

The antero-posterior inclination of the occlusal plane of the maxillary casts of 30 subjects was transferred to the Hanau 158-H2 articulator by Hanau earpiece face-bow and compared to that transferred to the Whip-mix articulator by a quick mount face-bow. The results indicated that the sagittal inclination of the occlusal plane was greater in the Whip-mix articulator. This result suggested that the Frankfort plane-maxillary occlusal plane relationship that exists in the patient is not transferred as accurately to the Whip-mix articulator.

### Introduction

A face-bow is used to record the antero-posterior and vertical relationship of the maxilla to the hinge

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axis of the temporomandibular joints and to transfer this relationship to the opening axis of an articulator.<sup>1-6</sup> Clinically, the Hanau 159-4 ear facebow, which is designed to be used with a Hanau 158-H2 articulator\*, relates the maxilla to the Frankfort plane by employing the external auditory meatus and the orbitale as reference points. When

\* Teledyne Hanau, P.O. Box 203,80 Sonwil Drive, Buffalo, NY 14224.

transferring to the articulator the ear pieces of the face-bow are seated on the auditory pins. The end of the orbital pointer attached to the face-bow is then elevated until it contacts the lower surface of the orbital plate which lies 7 mm above the condylar axis plane of the articulator. Studies of Gonzales *et al*<sup>4</sup> showed that the position of the orbital plate is 7 mm above the condylar axis level. This position permits the orientation of the maxillary cast in a vertical plane relative to the upper member of an articulator in the same way that the maxilla is related to the Frankfort plane [Fig. 1]. Thus, the sagittal inclination of the occlusal plane, when viewed on the articulator, will be similar to that of the patient sitting in an upright position looking at the horizon.

The Quick-mount face-bow which is designed to be used with the Whip-mix articulator\*\* uses the nasion as the anterior point of reference.<sup>7</sup> The cross bar of the face-bow is located 23 mm below the midpoint of the nasion guide which is approximately the position of the orbitale. During face-bow transfer the cross bar of the face-bow supports the upper arm of the articulator, and forms the mounting unit. The cross bar serves as the anterior point of reference and lies at the level of the condylar axis of the articulator instead of 7 mm above it<sup>2,3</sup> [Fig. 2]. Since the cross bar and axis of the articulator are on a plane which is parallel to the horizontal reference plane, the maxillary cast is positioned interiorly and as a result of this, the occlusal plane assumes a steep cant.

Several investigators have recognized the significance of accurately establishing the sagittal inclination of the maxillary cast on the articulator.<sup>1-3,5-8</sup> In the construction of complete dentures, improper sagittal inclination of the occlusal plane will not permit the positioning of maxillary anterior teeth on the denture base as they will appear in the patient's mouth assuming that the patient is sitting in an upright position looking at the horizon.<sup>7</sup> Furthermore, the posterior occlusal plane will not have the correct relationship in the patient's mouth preventing the masticatory forces from acting at right angles to the basal seat to help stabilize the denture.<sup>8</sup>

According to Weinberg,<sup>1</sup> steep inclination of the occlusal plane will cause an increase in the setting

\*\* Whip-mix corporation 361 Farmington Ave, P.O. Box 17182, Louisville, KY40217.

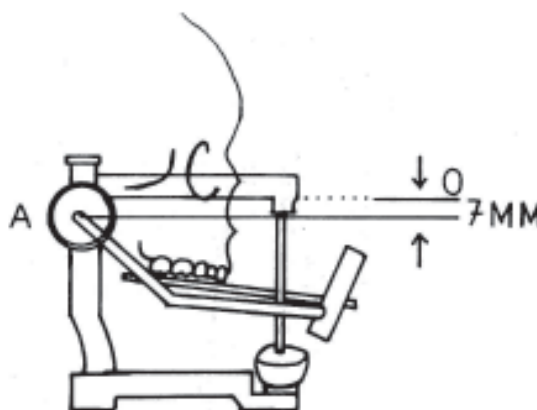


Figure 1. The orbital indicator (O) on the Hanau 158-H2 articulator is placed 7 mm above the level of the condylar axis (A) of the articulator.

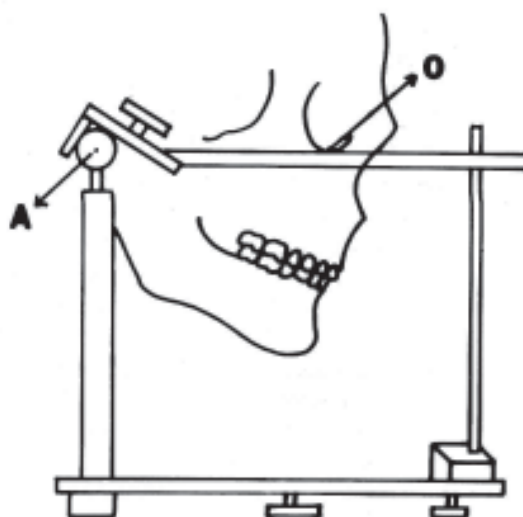


Figure 2. The cross bar of the quick mount face-bow is substituted for the orbital indicator (O). The condylar axis (A) of the articulator and the orbital indicator (O) lie on the same plane.

of the protrusive condylar inclination on the articulator to become greater than that present in the patient. In this manner, the occlusion developed on the articulator may produce an error on the balancing side in the patient's mouth.

The purpose of this study was to compare the sagittal inclination of the occlusal plane of the maxillary casts transferred to the Hanau 158-H2 articulator by a Hanau face-bow 159-4 with those transferred to the Whip-mix articulator by a Quick-mount face-bow.

## Materials and Methods

Thirty subjects comprising both sexes between the ages of 18 to 30 years and all having a full compliment of natural teeth, free from attrition of the occlusal surfaces, were selected. Irreversible hydrocolloid maxillary impressions were made for each subject and immediately poured in dental stone\*. For each of the thirty subjects, two face-bow records were taken with the Hanau face-bow 159-4 (Teledyne Hanau) and the Quick-mount face-bow\*\*. The two face-bow records for each patient were transferred to either a Hanau 1S8-H2 or to a Whip-mix articulator.

Each subject was seated in a dental chair in an upright position. The position of the right orbitale reference point was located using Salzman's<sup>9</sup> technique and marked with an indelible pencil. The Hanau 159-4 face bow nylon earpieces were placed into the external auditory meatus and the orbital pointer was related to the right orbitale. During face bow transfer the orbital pointer was related to the orbital indicator of the articulator and the maxillary cast was mounted with dental stone using a split cast method. The maxillary cast of the same subject was also mounted on the Whip-mix articulator using the Quick-mount face-bow according to the manufacturer's instruction.

Marks were made on the mesiobuccal cusp tip of the right maxillary second molar (M) and the mesioincisal edge of the right central incisor (A). The occlusal plane was thus represented from a point A on the right central incisor through a point M on the cusp tip of the molar [Fig. 3].

Two marks were established on the Hanau and Whip-mix articulators: mark C was made at the center of the condylar axis and mark I on the incisal pin at the condylar axis levels. The plane formed by marks C and I was parallel to the table top. These two marks were made to maintain stationary reference points on the articulators from which marks A and M were measured with a vernier caliper having a resolution of 0.01 mm.

A Boley gauge was used to measure linear distances between several points: (1) C and M (condylar axis and tip of mesio-buccal cusp); (2) I and M (point on incisal pin and tip of mesio-buccal

cusp); (3) I and A (point on the incisal pin and mesio-incisal angle of maxillary right central incisor); (4) C and A (condylar axis and mesio-incisal angle of maxillary right central incisor). Distances were drawn on a graph paper. The angle formed by lines CI, which represents the horizontal plane, and MA, which represents the occlusal plane (sagittal inclination angle of occlusal plane), was measured with a protractor to the nearest degree.

## Results

The observed values of the sagittal inclination angle of the occlusal plane was greater on the Whip-mix articulator than on the Hanau articulator. The mean angle of the occlusal plane on the Hanau articulator was 13.77 degrees and that on the Whip-mix articulator was 23.0 degrees (Table 1). The average differences in angle value between the Hanau and Whip-mix articulators was found to be 9.37 degrees.

A paired statistical "t" test was applied to the results for the angles of sagittal inclination of the cast mounted on the two articulators. The "t" value obtained was 15.794 with  $p < .005$ . The results were significantly different at the 0.5% level. The middle most (median) value for the sagittal inclination of the cast mounted on the Whip-mix articulator was 23 degrees as compared with 14 degrees for the cast mounted on the Hanau articulator (Table 1).

## Discussion

It has been suggested that bilaterally balanced occlusion is necessary for the stability of complete dentures to maintain the health of the oral tissues.<sup>10,11</sup> An accurate orientation of the sagittal

Table 1. Analysis of the two values of intersection angle between horizontal and occlusal plane.

	Whip-Mix Articulator (Degrees)	Hanau Articulator (Degrees)	Pooled Values (Degrees)
No. of observations	30	30	60
Average	23.0	13.8	18.3
Variance	16.9	9.6	12.9
Standard deviation	4	3	3.6
Median	23	14	18

\* Calestone, Detrey, AD. International Ltd. England

\*\* Whip-Mix Corp., New York.

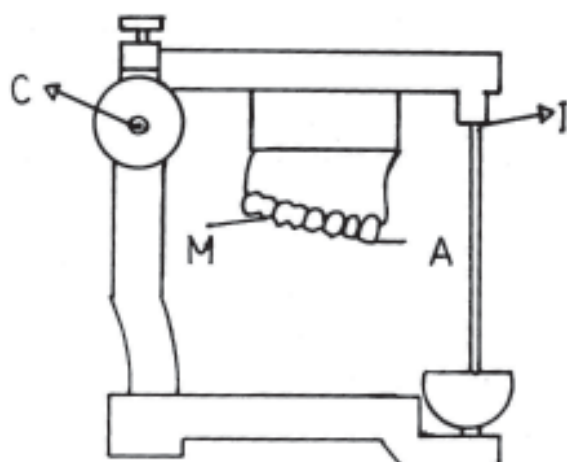


Figure 3. Measurement points: M, mesio-buccal cusp tip of right-second molar; A, mesio-incisal edge of central incisor; C, center of the condylar axis; 1, point on incisal pin.

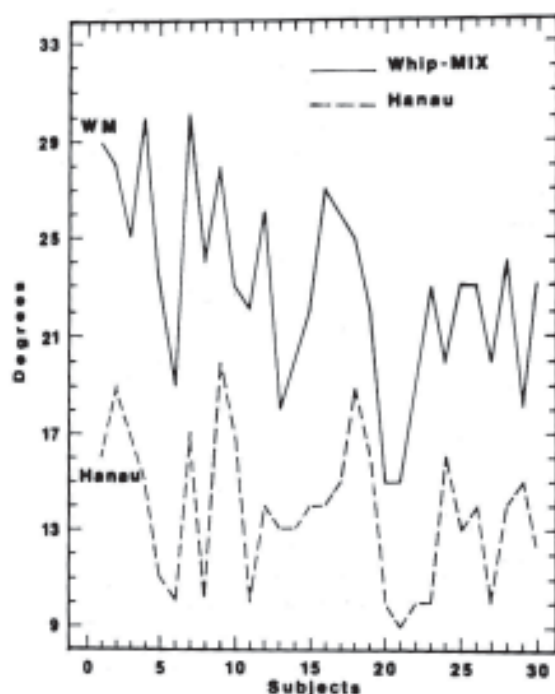


Figure 4. An analysis of the two values of angles of intersection between horizontal plane and occlusal plane.

inclination of the maxillary cast is an essential step in the development of balanced occlusion in complete dentures.

In this study the sagittal inclination of the occlusal plane of the maxillary casts to the horizontal reference plane (CI) on the Whip-mix articulator was found to be greater than that on the Hanau 158-H2 articulator. The average difference

between Hanau and Whip-mix articulators was found to be 9 degrees.

The reason for this difference between the two articulators is due to the position of the orbital point in the vertical plane. According to Gonzales and Kingery,<sup>2</sup> the orbital reference point is situated 7 mm above the condylar axis in a vertical plane suggesting that the orbitale indicator should be placed 7 mm above the hinge axis of the articulator.

In the Hanau 158-H2 articulator, the orbitale indicator (O) is located 7 mm above the axis (A) [Fig. 1], whereas in the Whip-mix articulator the crossbar of the face-bow locates the anterior reference point (O), not the nasion positioner. The crossbar of the face-bow is located 23 mm below the midpoint of the nasion positioner which is approximately the position of the orbitale (O). The axis of the articulator (A) and the crossbar (orbitale (O)) are in the same vertical plane [Fig. 21]. Therefore, when the maxillary cast is mounted, the incisal edge of the maxillary cast is more inferiorly placed and the cant of the occlusal plane increases.<sup>4,12</sup>

According to Weinberg,<sup>1</sup> increase or decrease in the cant of the occlusal plane does not affect centric occlusion. However, it will affect eccentric condylar readings. An increase in the cant of the occlusal plane results in an increase of the horizontal condylar guidance inclination on the articulator and may produce occlusal errors on the balancing side. This will adversely affect the stability of complete dentures during function.

## Conclusion

The sagittal inclination of the occlusal plane on the Whip-mix articulator is significantly greater than that on the Hanau 158-H2 articulator, when transferred using the Quick mount and Hanau 159-4 face-bow, respectively. The Frankfort plane - maxillary occlusal plane relationship that exists in a subject is not transferred to the Whip-mix articulator as accurately as to the Hanau 158-H2 articulator.

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