ISSN: 2581-5989
PubMed - National Library of Medicine - ID: 101738774

International Journal of Dental Science and Innovative Research (IJDSIR)
IJDSIR : Dental Publication Service
Available Online at: www.ijdsir.com
Volume – 3, Issue – 4, July - 2020, Page No. : 73 - 82

Evaluation of accuracy of transfer of the maxillary occlusal cant of two articulators using two facebows/semi adjustable articulator systems: An in vivo study

[1]Dr. Pooja Raval, Post graduate student, Department Of Prosthodontics Including Crown And Bridge, Manubhai Patel Dental College And Hospital, Vadodara, India

[2]Dr. Narendra Nirmal, Professor and Head, Department Of Prosthodontics Including Crown And Bridge, Manubhai Patel Dental College And Hospital, Vadodara, India

[3]Dr. Himanshu Arora, Reader, Department Of Prosthodontics Including Crown And Bridge, Manubhai Patel Dental College And Hospital, Vadodara, India

Corresponding Author: Dr. Pooja Raval, Post graduate student, Department Of Prosthodontics Including Crown And Bridge, Manubhai Patel Dental College And Hospital, Vadodara, India

Citation of this Article: Dr. Pooja Raval, Dr. Narendra Nirmal, Dr. Himanshu Arora, " Evaluation of accuracy of transfer of the maxillary occlusal cant of two articulators using two facebows / semi adjustable articulator systems: An in vivo study", IJDSIR- July - 2020, Vol. – 3, Issue -4, P. No. 73 – 82.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Aim: The aim of this study was to compare the accuracy of the angle made by Frankfort horizontal plane-occlusal plane on maxillary casts, mounted using the respective facebows on Hanau Wide-vue and Dentflex semi-adjustable articulators with cephalometrically derived Frankfort horizontal plane-occlusal plane angle as a control.

Material and Methods: Maxillary casts of 35 subjects were mounted on Hanau Wide-vue and Dentflex semi adjustable articulators following facebow transfer using respective facebow. The Frankfort horizontal plane-occlusal plane angles of these casts were measured using Prettyia's digital angle gauge. They were also subjected to a lateral cephalogram, and the occlusal cant was measured by radiographic tracing. Statistical Analysis: Using Paired T-test and Pearson correlation, the accuracy of the angle made by occlusal cant of mounted maxillary casts in each of the articulator was compared to the occlusal cant angle in lateral cephalogram.

Results: A mean difference of 2.19° was found between Hanau Wide-vue articulator and lateral cephalogram and a mean difference of 3.83° was found between Dentflex articulator and lateral cephalogram. Statistically, Pearson correlation value (r) obtained between Hanau Wide-vue and lateral cephalogram was 0.93 and between Dentflex and lateral cephalogram was 0.84.

Conclusion: From the statistical value derived, it can be inferred that the Frankfort plane to maxillary plane relationship that exists in a subject was transferred better

on a Hanau Wide Vue semi-adjustable articulator as compared to a Dentflex articulator.

Keywords: Occlusal cant, Sagital linclination Comparison of semi-adjustable articulator system.

Introduction

The role of a prosthodontist is to develop an occlusion that is compatible with the functional movement of the stomatognathic system.[1] Occlusal errors in the final prosthesis require a lot of time and effort to obtain an occlusal equilibration.[2] The inaccurate cast articulation is a major cause of such a problem. Eventually, accurate cast articulation results in correct static and dynamic occlusal relationships, accuracy in diagnosis-treatment planning, and accuracy in the final prosthesis occlusal relationships with reduced chair-side time.[2]

It is said that mouth itself is the best articulator, but operating whole procedure in the patient's mouth is neither easy nor realistic.[3] Therefore correct orientation of maxillary and mandibular casts should be transferred in articulator to simulate jaw movement. Maxillary cast in the articulator is the baseline from which all occlusal relationships start. The occlusal plane has to be in the same relation to the articulator's opening axis as it is in the patient, otherwise the articulator will not mimic the movements of the patient. An occlusion reset to an incorrect closure or opening arc will show deflective tooth contacts.[1] Hence, the Facebow transfers the “axis of rotation” of the temporomandibular joint accurately by orienting the cast of the maxillary dental arch in similar or a comparable distance to the hinges of the articulator as in the natural maxillary teeth. [4]

A reference plane is used in the orientation of the maxillary arch using a facebow. The Frankfort horizontal plane, which appears horizontal when the head is placed in the natural head position, is the most common plane used as a guide for the facebow transfer. The articulators are designed in such a way that upper member of articulator represents the Frankfort horizontal plane. The plane is also used for “natural” orientation of head for cephalometric films. To establish a correct plane of occlusion a proper selection of a third point of reference on a Frankfort horizontal plane is important.[1]

The angle formed by Frankfort horizontal plane and occlusal plane is known as occlusal cant, which should more or less be the same when occlusal plane is transferred onto the articulator.[5]

It is important to achieve two major objectives of restoration, i.e., occlusion and control of the form and the position of the teeth.[6]

This study was carried out to find out the ability of two face-bows of the earpiece type and two articulators of the arcon type in accurately transferring the maxillary occlusal plane from the patient to the articulator.

In this study, two different face-bow and semi-adjustable articulator systems were utilised to compare the accuracy of the angle made by Frankfort horizontal plane -occlusal plane on maxillary cast, mounted on Hanau Wide-vue articulator using Hanau spring facebow which uses orbitale as the third point of reference and dentflex articulator using dentflex facebow which uses nasion as the third point reference with cephalometrically derived Frankfort horizontal plane-occlusal plane angle.

Materials and Methodology

Source of Data: The present study was conducted in Department of Prosthodontics, Manubhai Patel Dental College, Vadodara. A total of 35 dentulous subjects participated in the study, after written informed consents were obtained. Ethical clearance was obtained from the University's Ethical Committee.

Participant selection: All the participants were informed about the nature of the study and were subjected to a complete diagnostic oral check up by the principal

investigator. Those who fulfilled the following criteria were included in the study.

Inclusion Criteria

- Age group: 18–25 years in which facial growth has completed
- Full complement of healthy and natural teeth (28-32 teeth)

Exclusion Criteria

- Missing teeth.
- Grossly malaligned teeth
- Grossly attrided or abraded teeth
- Presence of fixed or removable partial dentures
- Presence of any Disorder of Temporomandibular joint
- Presence of any pathologic and periodontal condition.
- History of previous or current orthodontic treatment.

Facebow transfer and mounting

Each participant was subjected to facebow transfer using two semi-adjustable articulator system included in the study. Two maxillary impressions were made of each of the subjects using a stock tray with irreversible hydrocolloid (Imprint; DPI, India) impression material, disinfected with 2%gluteraldehyde for 15 minutes, and casts were made using Type III dental stone (Dental Stone, Kalabhai, India). The articulators utilised in this study were the Hanau Wide Vue (HANAU^{TM} Wide-Vue, WhipMix Corporation, USA) and the Dentflex (B 8.889) articulators. Both these semi-adjustable articulators had earpiece type of face-bows and were of the arcon type. For each of the 35 subjects the facebow records were made (Figure 1 and 2). The facebow recordings were registered, and the maxillary casts were mounted on their respective articulators following the manufactures instructions having orbitale as the third point reference in the Hanau articulator and nasion as the third point reference in the Dentflex articulator. Placing the incisal guide pin in contact with the incisal table, the custom made plate was placed on the occlusal surface of mounted maxillary cast in flush plane, contacting the incisal tip of central incisor, and cusps of maxillary first molar. The angle formed by the upper member of the articulator and the custom made plate was measured using, Prettyia‘s digital angle gauge positioned on the plate. Prettyia‘s model: 1236e328fcc83ae870 digital angle gauge. Manufacturer: Prettyia has a magnetic base. Size: 2.17” ×2.09” ×0.98”. Resolution: 0.05°. Range: ±360°(Figure 3). The angle measurement for each subject mounted on the Hanau Wide-vue and Dentflex articulators were noted, respectively. (Figure 4 and 5)

Radiographic method

Lateral cephalograms of all the thirty five subjects were obtained. The Frankfort horizontal plane (FHP) was traced by joining the porion and orbitale. The porion is the most superior and outer bony surface point of the external auditory meatus and orbitale is the lowest point on the infraorbital margin. Another line of occlusal plane was traced by joining the incisal tip and cusp of maxillary first molar. The angle between FHP and occlusal plane was measured. (Figure 6)

Standard Protocol of Lateral Cephalograms

The lateral cephalograms of all subjects were recorded by a standardized X-Mind Pano D+, Sordex (Finland) machine equipped with a Digital CCD Sensor. Digora 2.9 software was used to obtain the images. All the lateral cephalograms were recorded at 10mA current and 85 kV. The film size used in the study was 8*10 inch. The participant’s head was positioned within the cephalostat ear rods, exerting moderate pressure on the external auditory meatus. The participant’s Frankfort horizontal plane was placed parallel to the floor. A locking nasal positioner was secured against the bridge of the subject’s nose and the central x-ray beam entered and exited the

subject near the horizontal axis of auditory meatus. Once properly positioned, the participantwas instructed to swallow and close in intercuspation, and remain still throughout the procedure. The lateral cephalogram readings were taken as control.

The findings of the clinical method and the radiographic method were compared. The data were statistically analyzed with Descriptive analysis (mean, standard deviation, CI), One-way ANOVA and Post HOC test.

Facebow transfer

Figure 1

Figure 2

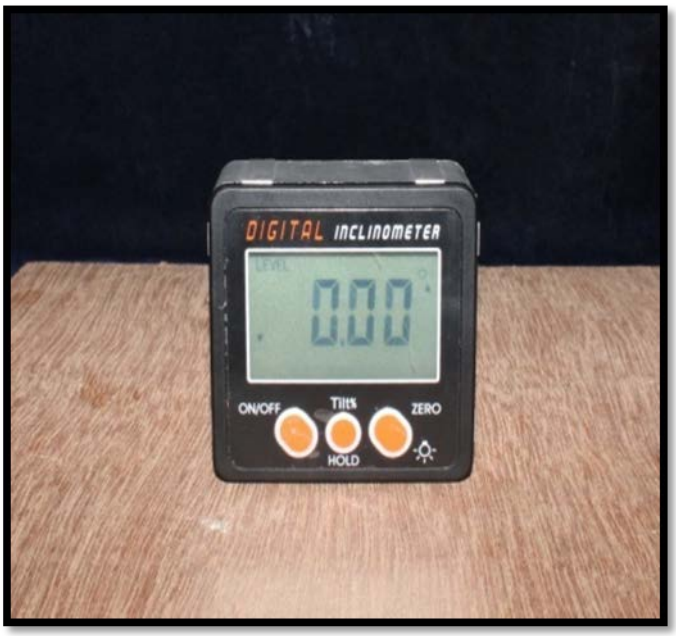


Figure 3: Digital angle guage

Occlusal cant measurement on articulators

Figure 4

Figure 5

Occlusal cant measurement on Lat. Ceph.

Figure 6

Figure 7

Results

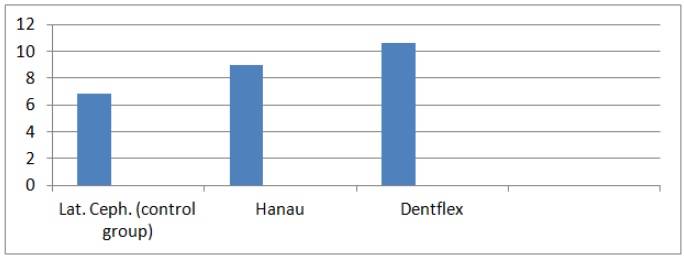
The mean values obtained from Hanau Wide-vue articulator and Dentflex articulator test groups and mean values obtained from control group are represented in Graph 1 and Table 1.

The occlusal cant recorded by Hanau wide-vue articulator varied from a maximum of 15.60^{o} to minimum of 4^{o}. In dentflex articulator the occlusal cant varied from a maximum of 17^{o} to minimum of 6^{o}. The maximum value of occlusal cant recorded from lateral cephalogram was 13^{o} to minimum of 4^{o}.

Table 1: Descriptive statistics of measurements

	Count	Mean	Standard deviation	Maximum	Minimum
Hanau	35	9.01	3.22	15.60	4
Dentflex	35	10.66	3.27	17	6
Lateral ceph.	35	6.83	2.86	13	4

Graph 1: Comparison of Occlusal Cant Values between articulator group and control group



The mean difference obtained from Hanau Wide-vue articulator and Dentflex articulator with comparison to control groups are represented in Graph 2.

Graph 2: Comparison of Occlusal cant values between two articulator groups and control group

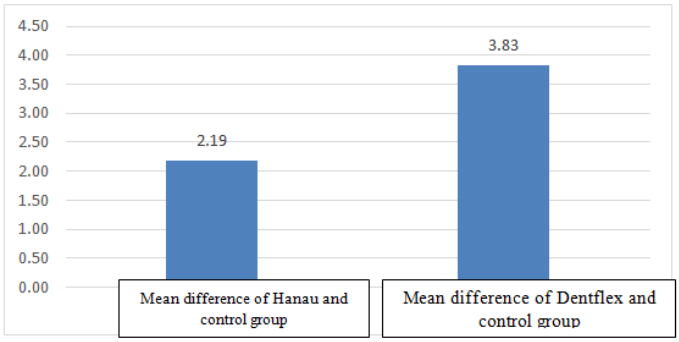


Table 2 gives the information about comparison of mean occlusal cant values between two semi-adjustable articulator system and radiographic method.

Table 2: Paired comparison of occlusal cant values between articulators and Lateral Ceph

		N	Mean ± SD	Mean difference ± SD	t	P VALUE
Pair 1	Hanau	35	9.01±3.22	2.19±1.17	11.01	<0.001
	Lat.ceph.(control group)	35	6.83±2.86			
Pair 2	Dentflex	35	10.66±3.27	3.83±1.78	12.77	<0.001
	Lat.ceph.(control group)	35	6.83±2.86			
Pair 3	Hanau	35	9.01±3.22	-1.65±1.51	-6.44	<0.001
	Dentflex	35	10.66±3.27			
Pair 4	Hanau difference	35	2.19±1.17	-1.65±1.51	-6.44	<0.001
	Dentflex difference	35	3.83±1.78			

For comparison of the mean values of occlusal cant in Hanau and Dentflex it is seen that the mean values of occlusal cant in Dentflex is higher with a difference of 1.64714 is statistically significant with a p value of <0.001.

On comparison of the mean values of occlusal cant in Hanau difference and Dentflex difference the mean values of occlusal cant in Dentflex difference is higher with a difference of 1.6471429 is statistically significant with a p value of <0.001.

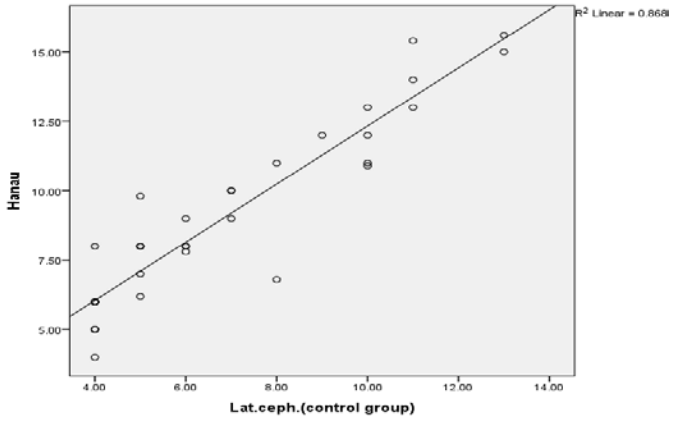
Pearson's correlation coefficient was used to find the correlation between two semi-adjustable articulator system and control group. A strong positive correlation (<0.001) was seen between the two semi-adjustable articulator system and lateral cephalogram.

Table 3. Comparison between test and control group and between the test groups using Pearson correlation

S.N	PARAMETERS BEING CORRELATED	N	Correlation(r)	P VALUE
1	Hanau & Lat.ceph.(control group)	35	0.932	**<0.001**
2	Dentflex & Lat.ceph.(control group)	35	0.84	**<0.001**
3	Hanau &Dentflex	35	0.891	**<0.001**

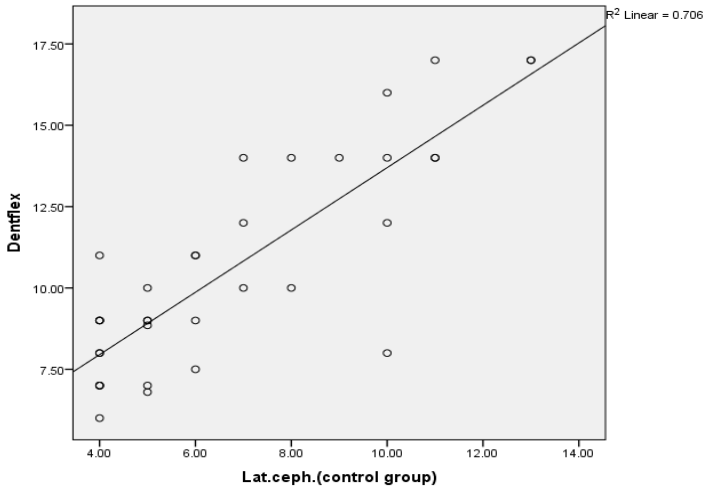
In graph 3 the X- axis represents occlusal cant values of control group and Y-axis represents occlusal cant values of Hanau group. The plotted data showed an uphill pattern as moving from left to right; this indicates a positive relationship between Hanau articulator and control group.

Graph 3: Correlation between Hanau Wide-vue semi-adjustable articulator and Lateral cephalogram



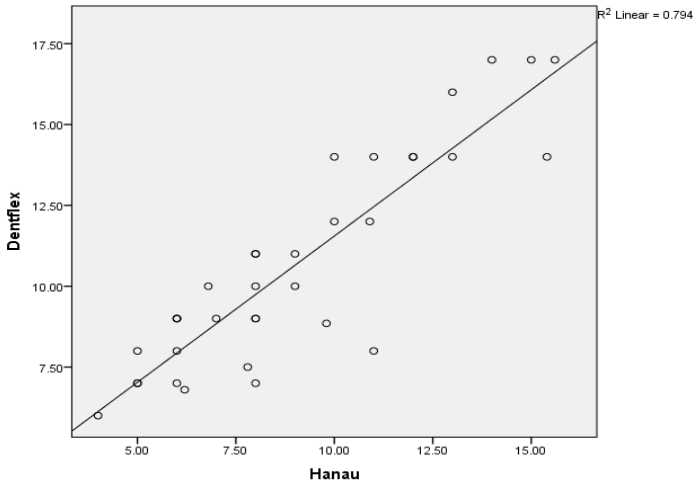
In graph 4 the X- axis represents occlusal cant values of control group and Y-axis represents occlusal cant values of Dentflex group. The plotted data showed an uphill pattern as moving from left to right; this indicates a positive relationship between Dentflex articulator and control group.

Graph 4: Correlation between Dentflex semi-adjustable articulator and Lateral cephalogram



In graph 5 the X- axis represents occlusal cant values of Hanau group and Y-axis represents occlusal cant values of Dentflex group. The plotted data showed an uphill pattern as moving from left to right; this indicates a positive relationship between Dentflex articulator and Hanau articulator group.

Graph 5: Correlation between Hanau Wide-vue semi-adjustable articulator and Dentflex semi-adjustable articulator



Discussion

In the field of prosthodontics semi-adjustable articulators are commonly used for their simplicity in handling and programming. Facebow is a calliper like instrument used to record the spatial relationship of the maxillary arch to some anatomic reference point or points and then transfer this relationship to an articulator. The use of two posterior points and an anterior point of reference for orienting a maxillary cast to an articulator has long been advocated. If the maxillary cast is not positioned in correct relationship with an articulator may result into an inadequate restoration with an undesirable appearance.[7]

Batwa et al[8] determined the influence of the occlusal plane angle on smile attractiveness as perceived by a group of adult orthodontic patients and dentists. Changing the occlusal plane angle does affect relative smile attractiveness. Literature supports that accurate transfer of orientation of the occlusal plane can significantly affect esthetics and function.[7] It also has implications in the field of orthognathic surgery.[1]

In this study, sagittal inclination of the occlusal plane of articulated maxillary casts to the horizontal reference plane using two different face-bow and articulator systems was recorded and compared with the cephalometric occlusal cant. Total thirty five subjects were studied. Subjects were selected between the age group of 18-25years. Age group was selected such because during development and growth period the inclination of occlusal plane decreases in upward and forward direction. This may have an effect on occlusal cant.[9]

The results of this study showed that the value of occlusal cant recorded by Hanau wide-vue articulator varied from a maximum of 15.60^{o} to minimum of 4^{o} with the average value of 9.01^{0}. This result is in accordance with the study carried out by Shetty et al[1], in which the occlusal cant using Hanau WideVue group, varied from a maximum of 15° to a minimum of 5.1° with a average value of 10.69°. The study by Nazier et al[5] also showed similar result showing maximum angle of 15° and minimum of 6° with the average value of 10.77°. The occlusal cant value of Hanau-H2 articulator was, however, higher in the study

conducted by Mohammad Abdullah et al.[10] with a mean angle of 13.77°

The maximum value of occlusal cant recorded from lateral cephalogram in the present study was 13^{o} to minimum of 4^{o} with a average value of 6.83^{0}. In the study carried out by Shetty et al[1] the occlusal cant for lateral cephalogram varied from a maximum of 13.3° to a minimum of 3.5° with a mean of 8.7°, there by showing similar results as shown in the current study. In another study conducted by Nazir et al[5], also showed similar result showing the maximum angle measured on cephalogram was 15°, whereas the minimum was 6°, with the mean angle being 9.61°.

In dentflex articulator the occlusal cant varied from a maximum of 17^{o} to minimum of 6^{o} with average value of 10.66^{0}. The occlusal cant values obtained from Hanau wide-vue articulator and Dentflex semi-adjustable articulator showed statistically significant difference with each other and with lateral cephalogram. The occlusal cant values of Hanau wide-vue articulator showed closer value to lateral cephalogram.

So many other studies proved superiority of one articulator over another. Like in a study by Sanath Shetty[1] et al also identified Hanau Wide-vue semi-adjustable articulator to be more accurate regarding transfer of occlusal plane in comparison with Artex Amann Girrbach semi-adjustable articulator. Hanau articulator showed occlusal plane angle to be less steep than those of Amann Girrbach articulator as well as it showed closer value to that of lateral cephalogram.

A same kind of finding was also identified previously by O'Malley et al[11] They compared the steepness of occlusal plane in three different articulators: Whip Mix, Denar and Dentatus. They observed that Whip Mix was closest to the cephalogram and flattened the occlusal plane by only 2°. The result of the Denar and Dentatus differed significantly from those of the cephalogram as they flattened the occlusal plane by 5° and 6.5° respectively.

Abdullah et al[12] compared the steepness of the occlusal plane on Whip Mix articulator and Hanau-H2 articulator. They found that the steepness of the occlusal plane of the cast when mounted on Whip Mix was significantly greater than the cast mounted on Hanau-H2. However, Abdullah et al.'s study did not include comparison to a control.

Nazir et al.[5] evaluated the sagittal inclination of mounted maxillary casts on two semi-adjustable articulator/face-bow systems (Hanau and Girrbach) in comparison to the occlusal cant on lateral cephalograms. Sagittal inclination of the cast with the Hanau articulator was closer to the cephalometric occlusal cant. The steepness of sagittal inclination was greater on the Girrbach semi-adjustable articulator.

Ramasamy et al[13] compared the variations in the inclination of occlusal plane of casts mounted on a Girrbach articulator using a facebow with a fixed value and customized nasion indicator. They evaluated twenty two patients and found that variation in occlusal plane was very minimal and close to the cephalometric value when using the customized nasion indicator compared to fixed value nasion indicator on the Girrbach articulator.

In these above discussed studies the articulator systems were used, had different anterior reference points. Therefore it can be questioned whether the anatomical difference between the anterior reference points and their corresponding landmarks, is responsible for such discrepancies in results.

Stade[14] reported that inaccurate occlusal plane transfer could cause the maxillary cast to exhibit unnatural cants when viewed in reference to the horizontal plane. This distortion of the cast may not be recognized by the dental laboratory technician who develops the preliminary anterior esthetics and occlusal plane using the horizontal

reference plane. The error may not be discernible until the prosthesis is placed in the mouth and it is evidenced by an incorrect cant to the incisal and occlusal planes. This inaccurate transfer of the orientation of the occlusal plane could potentially be misleading when restorations are being waxed up or fabricated in the laboratory. This could be overcome by try-in of provisional restorations which could be corrected as needed. However, the goal should be accurate transfer of occlusal plane orientation to maximize precision and minimize clinical chair-time for restoration placement.

In the present study it was evaluated, how much it is accurate to transfer that occlusal cant from the patient to the articulator using two different semi-adjustable articulators with their respective face-bow systems having two different anterior reference point indicators. The study made use of Hanau spring bow with Orbitale indicator and Dentflex face-bow with nasion indicator.

Most of the studies conclude that orbital indicator when used as an anterior reference point, occlusal cant is more precisely transferred to articulator with insignificant variation with cephalometric values. So, this study recommends, while establishing the occlusal plane one should correlate the occlusal cant value in lateral cephalogram after transferring.

The limitation of this study is that we have not included the edentulous patients and comparison between the two groups, can have different result for which further study is required.

Conclusion

Variations in the occlusal cant values were observed in the test groups. The following conclusions were drawn:

- Occlusal cant values measured from Hanau Wide Vue semi-adjustable articulator shows much more closer value with the occlusal cant values traced from lateral cephalogram.
- Dentflex semi-adjustable articulator shows steeper values with the occlusal cant values traced from lateral cephalogram.
- Thus, the transfer of occlusal cant is accurately possible in Hanau wide-vue semi-adjustable articulator compared to Dentflex semi-adjustable articulator.

Reference

1. Shetty S, Shenoy KK, Sabu A. Evaluation of accuracy of transfer of the maxillary occlusal cant of two articulators using two facebow/semi-adjustable articulator systems: An in vivo study. J Indian Prosthodont Soc 2016;16:248-52.
2. Zarbah MA. Accuracy of Cast Articulation: A Literature Review. Annals of Medical and Health Sciences Research. 2018.
3. Harcourt JK. Accuracy in registration and transfer of prosthetic records. Australian dental journal. 1974 Jun;19(3):182-90.
4. Khan FR, Ali R, Sheikh A. Utility of facebow in the fabrication of complete dentures, occlusal splints and full arch fixed dental prostheses: A systematic review. Indian J Dent Res 2018;29:364-9.
5. Nazir N, Sujesh M, Kumar R, Sreenivas P. Accuracy of two face-bow/semi-adjustable articulator systems in transferring the maxillary occlusal cant. Indian Journal of Dental Research. 2012 Jul 1;23(4):437.
6. Prajapati P, Sethuraman R, Naveen YG, Patel J. A clinical study of the variation in horizontal condylar guidance obtained by using three anterior points of reference and two different articulator systems. Contemporary clinical dentistry. 2013 Apr;4(2):162.
7. Nooji D, Sajjan SM. The third point of reference and its effect on the protrusive condylar guidance angles obtained in semi-adjustable articulator. The Journal of Indian Prosthodontic Society. 2008 Apr 1;8(2):71.

8. Batwa W, Hunt NP, Petrie A, Gill D. Effect of occlusal plane on smile attractiveness. The Angle Orthodontist. 2011 Sep 20;82(2):218-23.
9. Vukušić N, Lapter M, Muretić Ž. Change in the inclination of the occlusal plane during craniofacial growth and development. Collegium antropologicum. 2000 Jun 16;24(1):145-50.
10. Abdullah MA, Sherfudhin H. A comparative study of facebow transfer on hanau and whip-mix articulators. Saudi Dent J. 1994 Jan;6:8-12.
11. O'Malley AM, Milosevic A. Comparison of three face-bow/semiadjustable articulator systems for planning orthognathic surgery. Brit J Oral Maxfac Surg 2000;38:185-90.
12. Abdullah MA, Sherfudhin H. A comparative study of facebow transfer on hanau and whip-mix articulators. Saudi Dent J. 1994 Jan;6:8-12.
13. Ramasamy M, Karthigeyan S, Giri TC, Rajendran V, Shetty A, Deivanai M. Evaluation of the inclination of maxillary occlusal plane on mounted casts using a fixed value and customized nasion indicator in artex articulator: Facebow system-An in-vivo comparative study. Journal of pharmacy & bioallied sciences. 2013 Jun;5(Suppl 1):S54.
14. Stade EH, Hanson JG, Baker CL. Esthetic considerations in the use of face-bows. Journal of Prosthetic Dentistry. 1982 Sep 1;48(3):253-6.