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Identification Of a Novel Anterior Survey Point on The Incisal Pin of The Hanau Semi-Adjustable Articulator for Occlusal Plane Establishment: An In Vitro Study

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Abstract

The Occlusal plane is important in restoring the dental hard tissue with ordered pattern of occlusal contact and articulation to optimize oral function, occlusal stability, and aesthetics.

MATERIALS AND METHODS:

A total of 54 dentate subjects were divided into two groups. Maxillary and Mandibular primary impressions were made, and casts were obtained. Facebow records were made and transferred to Hanau Wide Veu Arcon semi adjustable articulator. Broadrick occlusal plane analyzer was attached to the upper member of the articulator, anterior and posterior survey points were obtained using lower canine as anterior survey point, distobuccal cusp tip of lower second molar (Group G1) and anterior point of condylar element (Group G2) as two different posterior survey points to establish the occlusal plane. The deviation in the occlusal plane between two groups was measured. A four-inch radius arch was extended from the central survey point onto the incisal pin of the articulator, and the distance from the first annular ring was measured to determine an alternative anterior survey point.

RESULTS

The deviation of the occlusal plane obtained by two different posterior survey points was statistically insignificant (P value < 0.05). The Mean values obtained for alternative survey point was 0.94mm and 1.00 mm from the first annular ring when measured by taking distobuccal cusp tip of lower second molar and anterior point of the condylar element as posterior survey points respectively.

CONCLUSION

There was no deviation in the occlusal plane obtained by two different posterior survey points. In case of missing or mutilated anterior survey point that is lower canine,1 mm above the first annular ring on the incisal pin of the articulator can be taken as alternative anterior survey point.

CLINICAL SIGNIFICANCE: Broadrick occlusal plane analyzer helps in establishing the occlusal plane in case of extensive rehabilitation. Obtaining an alternate anterior survey point on the incisal pin eliminates the need for canine as a survey point.

Keywords: Incisal Pin, Occlusal Plane, lower canine, oral health

INTRODUCTION

The prime objective of all oral rehabilitation procedures is to achieve ideal oral health and to preserve the status of the hard and soft tissues throughout the life of an individual. Restoring soft tissue and teeth to their optimum condition with ordered pattern of occlusal contact and articulation to optimize oral function, occlusal stability and aesthetics is paramount. [1] Raise in awareness of oral function and esthetics has led to an increase in demand for complete prosthetic rehabilitation.

In conditions such as severe attrition, supra eruptions, tipping, or rotation of teeth, where the occlusal plane is hampered, following the loss of posterior teeth it is important that the missing teeth are positioned in the most ideal location. [2-5] Therefore determination of the functional and esthetic occlusal plane becomes important, to maintain stable occlusion and normalized head and neck posture [6]. Clinical conditions such as removable and fixed partial dentures, implants, cleft palate, and prosthetic rehabilitation following maxillofacial injuries needs re-establishment of occlusal plane [7].

The occlusal plane is defined as the average plane established by the incisal and occlusal surfaces of the teeth; generally, it is not a plane but represents the planar mean of the curvature of these surfaces. Anterior teeth position is determined by the esthetics, phonetics, and the demand for anterior guidance. The position of posterior teeth is defined by 2 curves, an anteroposterior curve, referred to as the curve of Spee, and the mediolateral curve, referred to as the curve of Wilson. [8]

Curve of Spee described by Ferdinand Graf Spee, is an anatomical curve established by the occlusal alignment of the teeth as projected onto the median plane, beginning with the cusp tip of the mandibular canine, and following the buccal cusp tip of the premolar and molar teeth, continuing through the anterior border of the mandibular ramus, and ending at the anterior aspect of the mandibular condyle. It is known to enhance the crush-shear ratio between the posterior teeth and thus, improves masticatory efficiency of the posterior teeth [9].

It may be pathologically altered in conditions resulting from rotation, attrition, tipping, and extrusion of teeth. Restoration to such an altered occlusal plane can introduce posterior protrusive interference. [4,9]. The most popular techniques for determining an acceptable plane of occlusion are indirect analysis using mounted facebow transfer casts with correctly set condylar paths, direct analysis on natural teeth through selective grinding, and using the Broadrick occlusal plane analyzer by Pankey-Mann-Schuyler method. [8]

Broadrick Occlusal Plane analyzer developed by Broadrick, being the most popular instrument provides a simple and practical guide to determine the preliminary occlusal plane on diagnostic casts. Broadrick occlusal plane analyzer is a flag-like component attached superiorly to the upper member of an articulator. [10] The technique incorporates Monson's spherical theory of occlusion to develop the occlusal plane , where each cusp and incisal edge touches or conforms to a segment of the surface of a sphere 8 inches in

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diameter with its center in the region of the glabella [2].

Broadrick occlusal plane analyzer uses the tip of the canine as anterior survey point and the tip of the disto-buccal cusp of the second molar as a posterior survey point to establish the occlusal plane. Craddock et al stated that if the distal molar is unsuitable, then the most anterior point of the condylar element on the articulator may be selected as the posterior survey point. But in case of missing canine there is no alternative anterior survey point on the articulator [3,8].

So, the present study aims at checking the authentication of Broadrick Occlusal Plane analyzer using two different posterior survey points as well as establishing an alternative anterior survey point on the articulator.

MATERIALS & METHODS

Study population: Undergraduate and postgraduate students.

Sample size and design: A total of 54 samples were included in the study. The samples were divided into two groups-

Group G1: Disto buccal cusp tip of lower molar as posterior survey point.

Group G2: Anterior point of condylar element as posterior survey point.

The study population was selected irrespective of gender.

Patients aged 18-30 years with a full complement of permanent dentition (excluding the third molars) and an Angle's Class I molar relationship were included in the study. Patients with a history of orthodontic treatment, rotated, tipped, worn, or malaligned teeth, and those with removable or fixed partial dentures were excluded from the study.

PROCEDURE FOR PREPARATION OF STUDY MODELS

Maxillary and Mandibular primary impressions of subjects were made using dentulous stock impression trays with irreversible hydrocolloid (Alginate) impression material. Impressions were poured using dental stone (Type 3 gypsum products).

The anterior survey point was located on the cusp tip of the lower canine tooth, from which a long arc with a four-inch radius was drawn on the Broadrick occlusal plane analyzer with a compass, as an anterior survey line. The posterior survey point was located on the tip of the disto-buccal cusp tip of the lower second molar and a short arc was drawn on the flag to intersect the anterior survey line. The anterior point of the condylar element was considered as an alternative posterior reference point. Anterior and posterior survey lines bisect at the central survey point. The point of the compass was placed at the center of anterior and posterior survey lines (central survey point), and a 4-inch radius arc was drawn through the buccal surfaces of the mandibular teeth. and variation in the arcs obtained by these to posterior reference point was measured. The arc was extended anteriorly on the incisal pin of the articulator and point of contact was noted. The distance from this point to the superior annular ring was measured and noted.

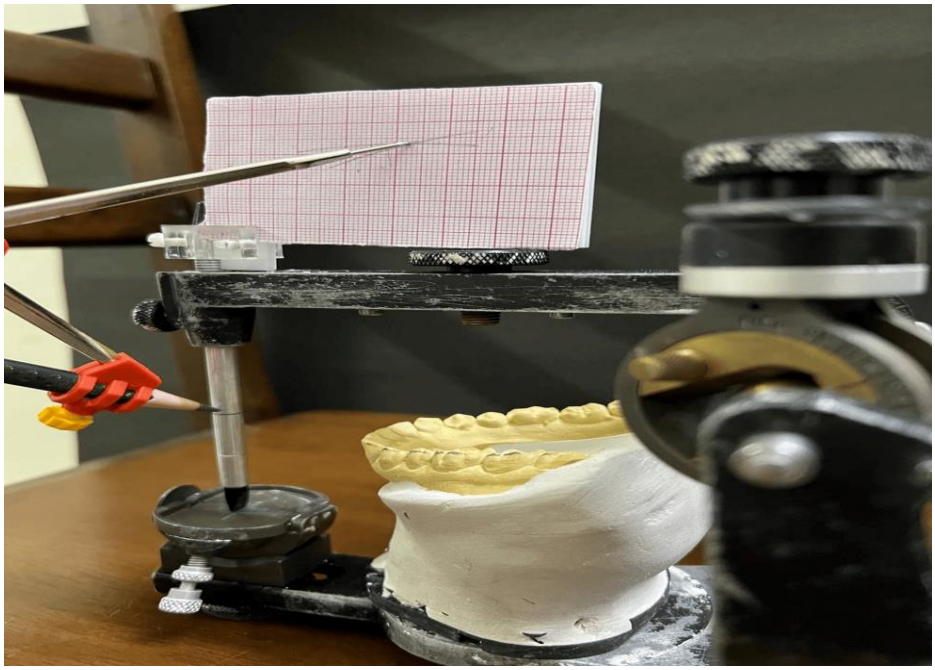

Figure 1: ALTERNATIVE SURVEY POINT ON THE INCISAL PIN OF THE ARTICULATOR

RESULTS

The present study aimed to compare the deviation in occlusal plane obtained by using Broadrick occlusal plane analyzer by taking distobucal cusp tip of second molar and anterior point of condylar element as posterior survey point. And establish an alternate anterior reference point.

54 samples that were mounted on a semi adjustable articulator following facebow record were divided into two groups.

GROUP 1 (G1): Values obtained by using the distobuccal cusp tip of lower second molar as posterior survey point.

GROUP 2 (G2): values obtained by using anterior point of condylar element as posterior survey point.

Values were measured for first bicuspid and first molar in three areas : mesio-buccal, mid-buccal and disto-buccal.

Comparison between the distance from the first annular ring (37mm) when 4-inch radius arch from the central survey point is extended anteriorly on to the incisal pin of the articulator, while taking distobuccal cusp tip of the lower second molar and anterior point of the condylar element as posterior survey points.

Study variables	N	Mean	Std. Deviation	Percentiles			Test statistic	P value
				25th	50th (MEDIAN)	75th		
Premolar Mesio Buccal(G1)	54	.417	.4929	.000	.000	1.000	-2.927	0.003
Premolar Mesio Buccal(G2)	54	.685	.6680	.000	.500	1.000		
Premolar Mid Buccal(G1)	54	.463	.6284	.000	.000	1.000	-2.703	0.007
Premolar Mid Buccal(G2)	54	.769	.7250	.000	1.000	1.000		

Premolar Disto Buccal(G1)	54	.472	.6326	.000	.000	1.000	-2.721	0.007
Premolar Disto Buccal(G2)	54	.778	.7627	.000	.500	1.000		
Molar Mesio Buccal(G1)	54	.472	.6897	.000	.000	1.000	-1.762	0.078
Molar Mesio Buccal(G2)	54	.685	.7968	.000	.500	1.000		
Molar Mid Buccal(G1)	54	.556	.7439	.000	.250	1.000	-1.976	0.048
Molar Mid Buccal(G2)	54	.806	.8379	.000	1.000	1.000		
Molar Disto Buccal(G1)	54	.509	.7235	.000	.000	1.000	-1.964	0.05
Molar Disto Buccal(G2)	54	.769	.8726	.000	.500	1.000		

Table 1: Comparison in the deviation of the occlusal plane established by taking two different posterior survey points measured for first bicuspid and first. molar in three areas mesio-buccal, mid-buccal and disto-buccal.

Mean value obtained was 0.94mm and 1.00 mm from the first annular ring when measured by taking distobuccal cusp tip of lower second molar and anterior point of the condylar element as posterior survey points respectively. The values showed no statistically significant difference between group 1 and group 2. This shows that anything within 1 mm from the first annular ring can be considered as an alternative anterior point.

Group	N	Mean	Std. Deviation	Percentiles			Test Statistic	P value
				25th	50th (Median)	75th		
G1	54	.94	.770	.00	1.00	2.00	-0.536	0.5920
G2	54	1.00	.679	1.00	1.00	1.00		

Table 2: Comparison between the distance from the first annular ring (37mm) when 4-inch radius arch from the central survey point is extended anteriorly on to the incisal pin of the articulator, while taking distobuccal cusp tip of the lower second molar and anterior point of the condylar element as posterior survey points

DISCUSSION

Occlusion is not only contact between the teeth but also as a dynamic, morphological, and functional relationship between all components of the stomatognathic system, which has a significant impact on chewing, swallowing, and speech. [11] Occlusal plane is the average plane established by the occlusal and incisal surfaces of the teeth passing through the cusp tip of the mandibular canine and the buccal cusp tips of the mandibular premolar and molar teeth and extends posteriorly to pass through the anterior point of the mandibular condyle. [12]

Occlusal plane analyzer was first introduced by Pankey and Mann to establish the occlusal plane and its incorporation in full mouth rehabilitation. [13]

Brodrick occlusal plane analyzer is designed as a simple tool used to establish occlusal plane in rehabilitation of partially edentulous mouths. It uses anterior and posterior survey points to develop the occlusal plane [14]. Craddock et al stated that when the position of the distal molar is unsuitable then the most anterior point of condylar element on the articulator may be selected as posterior survey point. [3]

For partially edentulous patient when the occlusal scheme is disturbed posteriorly by over eruption, rotation, and tipping the Broadrick occlusal plane analyzer is used for occlusal plane orientation and for reconstruction of the Curve of Spee. In 1919 Monson in his anthropological study proposed the existence of an imaginary anteroposterior curve of the teeth forming a sphere, with the center of rotation located in the region of the glabella, and its radius was found to be 4 inches. [13]

Curve of Spee is an anatomical curve established by the occlusal alignment of the teeth, as projected on to the median plane, beginning with the cusp tip of the mandibular canine and following the buccal cusp tip of the premolar and molar teeth, continuing through the anterior border of the mandibular ramus, and ending at the anterior aspect of the mandibular condyle.

Spee in his studies suggested that this geometric arrangement defined the most efficient pattern for maintaining maximum tooth contacts during chewing. [8]

The morphologic arrangement of the teeth in the sagittal plane has been related to the slope of the articular eminence, molar cusp height, incisal vertical overlap, and the amount of posterior contact. Matched interactions between these features and the curve of Spee ensure optimum occlusal function and posterior disocclusion. [4,15]

The present study investigated the deviation in occlusal plane obtained using Broadrick occlusal plane analyzer taking two different posterior reference survey points in completely dentate subjects.

A total of 54 subjects were examined for deviation in occlusal plane. First group (G1) used lower canine as anterior reference point and disto-buccal cusp tip of the lower second molar as posterior survey points whereas the second group (G2) used Anterior point of the condylar element as a posterior survey point.

Wilcoxon Sign Rank Test used in the present study shows no significant deviation in the occlusal plane obtained by using two different posterior reference survey points that is distobuccal cusp tip of lower second molar and anterior point of condylar element, when measured at three different regions that is mid-buccal, mesio-buccal, disto- buccal in the first bicuspid and first molar as (Table *1*).

These results were consistent with the findings of the study done by the Craddock et al, in the year 2005 were he reported that 55 patients among 100 Caucasian patients did not have any deviation from the theoretically ideal occlusal plane obtained using the Broadrick occlusal plane analyzer. [3] Following year Craddock et al in his investigation that centered around determining whether patients with missing posterior teeth were more likely to have deviated occlusal plane showed both statistically and clinically significant deviation of individual teeth from the Broadrick occlusal curve. [3]

Study conducted by Tanvi et al, compared the accuracy of Broadrick occlusal plane analyzer in case of fully dentulous and individuals with few missing posterior teeth, found that the Deviation from the occlusal plane to be marked in subjects who had missing posterior teeth, while the deviation in fully dentulous subjects was minimal which was in agreement with the present study [16]. Similar study done by Manvi et al and Das S et al also showed deviation from the Broadrick curve between patients who have lost posterior teeth. These studies did not compare the deviation in occlusal plane obtained using two different posterior survey points. [2,9]

Whereas the study done by Banasr FH et al showed that there was no statistical difference between the two reference points in the partially edentulous side, but a statistical variation was found between the partially edentulous side and the control dentulous side in relation to the leveling of the curve of Spee [17]. These results can be compared to the present study as there was no deviation in the occlusal plane when two different posterior survey points were used.

This study aimed to establish an alternative anterior survey point independent of the hard tissue. The articulator used in the study was Hanau wide vue I articulator, (Whipmix Co). The type of articulator is Arcon, semi-adjustable. The incisal pin of the articulator presents with two annular grooves, at 37 and 54 mm below the Frankfort Horizontal Plane. These grooves form arbitrary vertical landmarks for alignment of the incisal edge of the maxillary centrals when making a Facebow transfer. The 37 mm line is based in part on the Bonwil Triangle and results in a horizontal appearing plane of occlusion. [18]

When the 4-inch radius arc drawn from central survey point through the buccal surfaces of the mandibular teeth was extended anteriorly on to the incisal pin of the articulator, the arc ended close to the annular ring corresponding to 37mm.

Mean value obtained by extending the curve on to the incisal pin of the articulator was 0.94 and 1.00 mm above the first annular ring, when measured by taking distobuccal cusp tip of lower second molar and anterior point on the condylar element of the articulator respectively and it is statistically insignificant.(Table 2) .Therefore 1 mm above the first annular ring can be taken as alternative anterior survey point.

Establishing curve of Spee in case of rehabilitation of long span posterior edentulous arches or in case of full mouth rehabilitation is important as supraeruption or movement of a tooth following the loss of antagonist contact can hamper the occlusal. Broadrick occlusal plane analyzer acts as a simple tool in establishing occlusal plane and the present study established an alternative anterior survey point on the articulator, and no difference in the occlusal plane obtained by two posterior survey point.

In the present study deviation in the occlusal plane using Broadrick occlusal plane analyzer taking two different posterior survey points, that is distobuccal cusp tip of lower second molar and anterior point of the condylar element was evaluated and in case of unsuitable anterior survey point, an alternate anterior survey point on the incisal pin was established.

Conclusions

• There is no deviation in the occlusal plane obtained by using distobuccal cusp tip of lower second molar and anterior point of condylar element as the posterior survey points.

• In cases where the anterior survey point (i.e., the lower canine) is missing or mutilated, a point 1 mm above the first annular ring on the incisal pin of the articulator can serve as an alternative anterior survey point.

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