# **Natural Head Position and Inclination of Craniofacial Planes**

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*Purpose:* To assess the angles between craniofacial planes and the gravity horizontal plane (GHP). *Materials and Methods:* The plumb line was hung from the ceiling, the Fox plane (FoxP) was placed in the mouth, and 56 Angle Class I subjects were photographed in a natural head position. FoxP represents the extraoral view of the occlusal plane. *Results:* In frontal view, bipupilar plane (BP) and occlusal plane (FoxP) were almost parallel to GHP. In lateral view, FoxP was almost parallel to GHP, but Frankfort horizontal plane (FHP) and Camper's plane (CP) were not. FoxP and CP were not parallel. *Conclusion:* CP is not a reliable landmark for occlusal plane reconstruction. FHP does not represent GHP. *Int J Prosthodont 2006; 19:279–280.* 

**C**orrect occlusal plane orientation is very important in prosthodontic reconstructive treatment therapy and should be similar to the occlusal plane of lost natural teeth.<sup>1,2</sup> To proceed with clinical and laboratory phases, it is necessary to precisely register the planes and to correctly orient the dental casts in the articulator.

The aim of this study was to assess the angles between the occlusal and craniofacial planes, as well as to assess the angles between the occlusal and craniofacial planes and the real gravity horizontal plane (GHP).

## **Materials and Methods**

Fifty-six dental students with complete natural dentition and Angle Class I occlusion were selected. Exclusion criteria were: overjet over 2 mm, overbite over 4 mm, previous prosthodontic or orthodontic treatment, previous craniofacial trauma or surgery, temporomandibular disorders, and facial asymmetries. A Fox plane (FoxP) (Candulor AG) was clenched between the teeth. FoxP represents the extraoral view of the occlusal plane. A plumb line was hung from the ceiling to identify gravity vector (true vertical). The subject was asked to stand with natural head position (NHP).<sup>3,4</sup> Photographs were obtained with a digital camera (Fuji Finepix A310, 3.1 megapixel  $3 \times$  optical/2.9× digital zoom) on an adjustable tripod (Manfrotto Tripod Digi MN714SHB) elevated to the height of the FoxP (Fig 1).

The ISSA computer program (VAMS) was used for direct angular measurements of digital images. Statistical analysis was performed (SPSS 12 for Windows). Kolmogorov-Smirnov test, descriptive statistics, 1-sample Student *t* test, and independent *t* test were used.

## **Results**

No significant differences were found between male and female subjects (P > .05). The results (descriptive statistics, 1-sample *t* test) are presented in Tables 1 and 2. In frontal view, bipupilar plane (BP) and FoxP were parallel to GHP. In lateral view, FoxP was parallel to GHP, but Frankfort horizontal plane (FHP) and Camper's plane (CP) were not parallel to GHP.

## Discussion

Accurate mounting of dental casts is achieved by transferring the 3-dimensional relationship of the maxillary arch to an articulator using a facebow, which is related

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**Fig 1** Subject in natural head position clenching a Fox plane. True vertical is represented by a plumb line. *(left)* Frontal view; *(right)* lateral view.

**Table 1** Angles (Means and SDs) and Significance of Difference Between Craniofacial Planes (FHP, CP, and BP) and GHP, Between FoxP and GHP, and Between FoxP and CP

Angle	Mean (deg)	SD	t	Р	
FHP-GHP (lateral view) <sup>†</sup>	-10.330	6.65	-11.624	<.01*	
CP-GHP (lateral view) <sup>†</sup>	5.384	7.69	5.389	<.01*	
FoxP-GHP (lateral view) <sup>†</sup>	1.42	4.81	1.511	.132	
BP-GHP (frontal view) <sup>‡</sup>	-0.25	1.94	-0.966	.339	
FoxP-GHP (frontal view) <sup>‡</sup>	-0.53	1.1	-1.571	.129	
FoxP-CP	3.964	5.57	5.295	<.01*	

\*Significant at 99% probability level.

<sup>†</sup>Positive angle, downward-oriented to GHP; negative angle, upward-oriented to GHP.

<sup>‡</sup>Positive angle, counterclockwise to GHP; negative angle, clockwise to GHP.

**Table 2**Angles (Means, SDs, Minimums, andMaximums) Between FoxP and FHPBetween CP andFHP

Angle	Mean (deg)	SD	Minimum	Maximum
FoxP-FHP	11.75	5.550	0	27
CP-FHP	15.73	2.676	8	21

to a plane of reference. The most common reference plane is FHP, which has been assumed to be horizontal when a patient is in erect posture with NHP. According to the results of this study, FHP diverges from GHP (Table 1), which is in accordance with Ercoli et al.<sup>5</sup>

The results also show that FoxP is almost parallel to GHP (Table 1). It would be impulsive to assume that NHP is influenced or determined by the position of occlusal plane, and further studies are needed. Contrary to the results of this study, Ferrario et al<sup>3</sup> found that the occlusal plane deviated from GHP by about 14 degrees.

This difference could not be explained by variations of NHP, as NHP was found to be highly reproducible in both radiographic and photographic techniques.<sup>3,4</sup>

Most textbooks on prosthodontics advocate parallelism of FoxP and CP for establishing the inclination of occlusal plane posteriorly. The results of this study revealed a statistically significant difference between FoxP and CP (Table 1), suggesting that CP is not a reliable landmark for establishing the occlusal plane posteriorly. An occlusal plane that was established to be parallel to CP would be too high posteriorly on mandibular dentures. Mean angles between FoxP-FHP and CP-FHP (Table 2) are in accordance with other authors.<sup>3–5</sup> Within the limitations of this study, the following conclusions can be made: In frontal view, the orientation of BP and FoxP was roughly horizontal in NHP. Parallelism to BP is a suitable landmark for reconstruction of the occlusal plane. In the lateral view, parallelism with CP is not a reliable landmark for establishing the occlusal plane. In NHP and when a subject is in erect posture, the occlusal plane is almost parallel to GHP. However, further research is necessary. The data obtained in this study could be useful in prosthodontic reconstructive treatment procedures.

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