How to Design an Ideal Maxillary Plane of Occlusion

For Fixed or Removeable Prosthetics

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There are several techniques to establish a new plane of occlusion. Dental-Facial jigs using a facebow, Kois dento-facial analyzer, and several more from various articulation systems are commonly utilized. This writing will show the technique of using the HIP impression technique for mounting maxillary casts in conjunction with a Digital Stick Bite™ to verify the accuracy of the mounting. Several techniques listed above can be accurate; however, they are very subjective to the accuracy of the X-Y and Z axis recorded for transfer to the lab and be unique to each skull. Lab data suggests that less than 25% of the mounting records sent to Ocean Ceramics are inaccurate and flawed. When developing a new smile or maxillary arch of prosthetics, it is critical that the X,Y and Z axis are recorded properly and consistently with a very high percentage of accuracy. When treatment planning edentulous reconstructions like All-On-4 implant cases, Full Zirconia arches on implants or just non-retained denture cases, it is critical to establish a level foundation within the skull to evenly distribute forces received from the function of the mandible. “When the plane of occlusion is related to the sphenobasilar synchondrosis in an optimal three-way alignment, the vectors of force created by the closing muscles are directed to the center of the cranium in a symmetrically balanced way, causing enhancement of cranial motion and creating harmony within the brain, craniosacral mechanism, and the rest of the central nervous system. Thus, harmony and homeostasis is maintained and overall body health is enhanced.”

It is critical that any mounting record is verified with another record prior to proceeding with any prosthetic design and treatment at the planning/design phase and subsequent stages. The 2 critical records required for this technique is the HIP impression and Digital Stick Bite™ photograph.
1) The Digital Stick Bite™ photograph is a portrait image, cheeks retracted, teeth slightly apart to see plane of occlusion, hair behind the ears, patient stares directly into lens, and the photographer aims the lens parallel to the anterior-posterior (Z) axis.

2) The HIP (Hamular notch-Incisive Papilla) impression is best taken with an alginate replacement impression material (Status Blue from DMG) which enables the lab to perform multiple pours maintaining accuracy of casts for various purposes. Just in case the hamular notches are not captured with clarity on first impression, reline the most posterior border area with a small amount of PVS bite registration material (O-Bite from DMG) and re-insert the impression for 30 seconds.

HIP Reference Plane

The Maxillary Model is Orthopedically Aligned with Skeletal landmarks……..

*accuracy? 85-90% correct (based on a study by Dr. Harry Cooperman of 10,000 skulls)

Images courtesy Dr. Jim Carlson DDS
The data for the accuracy of an HIP plane of occlusion was originally studied and published by Dr. Harry Cooperman from Pennsylvania in the early 1960’s. He studied over 10,000 skulls and concluded the HIP plane of occlusion was 85-90% correct with each unique skull. Dr. James Carlson later published in several publications the utilization of HIP mounting and its accuracy with his treatment protocols. Below is an additional study by Dr. Dipak Thapa from the Department of Prosthodontics Kantpur Dental College in Kathmandu, Nepal supporting the accuracy of HIP mountings in prosthodontic protocols. After processing 100’s of Full Mouth Rehabilitations at Ocean Ceramics from several doctors in North America, the HIP impression and mounting protocol has been consistent with Dr. Cooperman’s research.

When we process cases in a commercial lab setting, we receive several different records for several different articulation systems. The Acculiner® and Panadent® articulators are very popular in the Pacific Northwest and Western Canada area. In the following illustration, there is a comparative analysis of the 2 articulators aligning the average values of the ear and to the incisal edge of the incisors on the Z axis horizontal mounting plane.
Utilizing the HIP mounting landmarks on either articulator has proven to be consistent with doctors preference.
Once we have the maxillary casts mounted, we proceed to evaluate each patient’s face for any asymmetries. If we accept that the patient’s eyes are symmetrically level in the face, we will utilize the pupils as a reference plane for analysis of X axis. In a perfect analysis, the eyes, ears and maxillary planes are all level. Eyes can be adjusted with cranial chiropractic adjustments, maxillary plane of occlusion can be adjusted orthodontically or prosthodontically; but, the ottic plane in line with the ear canals is static and can not be altered.

Clearly, the following patient has asymmetrical eyes and the pupillary line can’t be used as a reference plane to the maxillary plane of occlusion. In this situation, a Kois dental-facial analyzer is helpful in capturing a mounting record for the maxillary.
However, with the following patient, Marga, we are accepting the symmetry of her eyes to be utilized with a Digital Stick Bite™ analysis to verify that her mounting is consistent with the dental-facial analysis.
In order to level the image, the Digital Stick Bite™ photo is loaded into PhotoShop, activate the Measure Tool function on left toolbar, click icon onto the 1 pupil and drag a line right through the other pupil. Leaving the line in place, click Image-Rotate Canvas-Arbitrary and the Rotate Canvas box will pop up showing the precise degree of discrepancy from horizontal that the reference line is showing. In the case of the above image, this amount is 0.32 degrees “clockwise” off horizontal. The gold standard for dental-facial analysis is “level to the floor”, and this reference plane when corrected with the Measure Tool is pixel accurate. If the photographer is canted in the image capture at 30°...... the image can be corrected and analyzed for an accurate X and Y axis analysis. It is critical for this record that the photographer positions the camera lens parallel/level with the Anterior-Posterior-Z plane when taking the photo. A pitch discrepancy between the maxillary arch and the camera lens will distort the analysis for all 3 axis’ to be consistent with the mounting for analysis. The photography for Marga’s record is excellent positioning for analysis.

“clicking” OK and the image is rotated to be perfectly level to the floor. Yellow outline shows amount of horizontal correction.
Marga’s dentition on the HIP mounted maxillary cast and the levelled portrait image provides a proven foundation to proceed with designing her new dentition to a level plane of occlusal foundation. It was determined that her new smile would be designed around a central length consistent with the length of tooth 2.1 and the posteriors were designed with appropriate Curve of Spree and Wilson consistent with the angle of eminence unique to her skull. It was determined that an Ideal Class 1 Occlusal Pattern as written by Dr. James Carlson in OrthoCranial Occlusion 1997. “Ideal Class 1 Occlusal Pattern is when the angle of the slope of the articular eminence is moderate (30° to 60°). The angle of the anteroposterior curve is then moderate.”
One of the key benefits of the HIP mounting technique and Digital Stick Bite™ is the consistency of utilizing the records on subsequent stages of treatment. After Marga’s maxillary arch was designed and provisionalized, her set up was analyzed again with a Digital Stick Bite™.
Finally, with a verified provisional set up facially and the posteriors engineered for her unique anatomy of her skull, the final restorations were then processed in eMax® lithium disilicate.

Once the maxillary arch is completed with a newly engineered dentition, the mandibular must be stabilized with a new vertical dimension. Dr. Brad Bishop from Kelowna, BC already had the new VDO worked out and stabilized with occlusal composite pads on the lower first molars prior to restorations processed. The mandibular arch will be next for treatment. Our full mouth rehabilitation protocol is always to facially design the anteriors and engineer the posteriors to provide a stable foundation in the skull so that any forces received from the mandibular teeth are balanced evenly through the skull.

In conclusion, the purpose of this writing is to show how accurate and consistent 2 key records can be in designing and verifying facially engineered esthetics for any unique patient with skeletal landmarks and a properly captured photograph.....an HIP impression (alginate replacement eg. Status Blue from DMG) and a Digital Stick Bite™ photograph. After processing 100’s of full mouth rehabilitations with both fixed and removable prosthetics, this technique has delivered the most consistent results from clinic to lab and into the final restorations.

References:

1. OrthoCranial Occlusion by Dr. James Carlson DDS  copyright ©2003 Blue Pine Unlimited

Evaluation of the Reliability of Hamular Notch-Incisive Papilla Plane (HIP) in establishing Occlusal Plane
  By Dr. Dipak Thapa Dept. of Prosthodontics, Kantpur Dental College ; Kathmandu, Nepal

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