The Application of the HIP-Analyzer for the Evaluation of the Maxillary Occlusal Plane Topography

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The orientation of the upper occlusal plane is an important component in many clinical situations. Over the course of one hundred years, the main reference planes were the Francfort and Camper's planes[1,2]. In 1955, Cooperman and Willard found that HIP plane (hamular-incisive-papilla) anatomically related to the cranium[3]. The application of the HIP-plane in prosthodontics and orthodontics is actively discussed today. Many studies have shown that the HIP plane has been observed to be a more stable reference point in determining the orientation of maxillary occlusal plane position[4,5]. Other studies have shown that the HIP plane has the smallest angle with an occlusal plane (2.61°±0.81°)[6].

The use of the HIP-plane fixed intraoral markers (Hamulus – Incisive Papilla) makes it possible to mount the upper model in the space of the articulator without the facebow, as well as to analyze the position of the maxilla dentition, and to make a prosthetic or an orthodontic treatment plan according to the orthocranial occlusion[4,7,8]. To do so, the dentist has to make the maxillary dentition impression with hamulus notches *(Figure 1)* which must be depicted on the jaw's plaster model *(Figure 2)*. After that, the dental technician, with the help of a special mounting table, mounts the maxillary model to the upper frame of the articulator orienting the model in accordance with the HIP-plane marks *(Figure 3)*. This method is easy to use, however, it has certain disadvantages. It is not always possible to make the correct impression of the hamulus notches in their whole depth, because when the mouth is widely open, the hamulus notches are tense and they smooth the contours of the above-indicated hamulus, which leads to the changing of the maxillary model position. Moreover, making and mounting the models adds extra steps and casues delays in the assesment of tthe postion of the upper occlusal plane.

Figure 1. Impression of the maxilla with HIP-plane points.

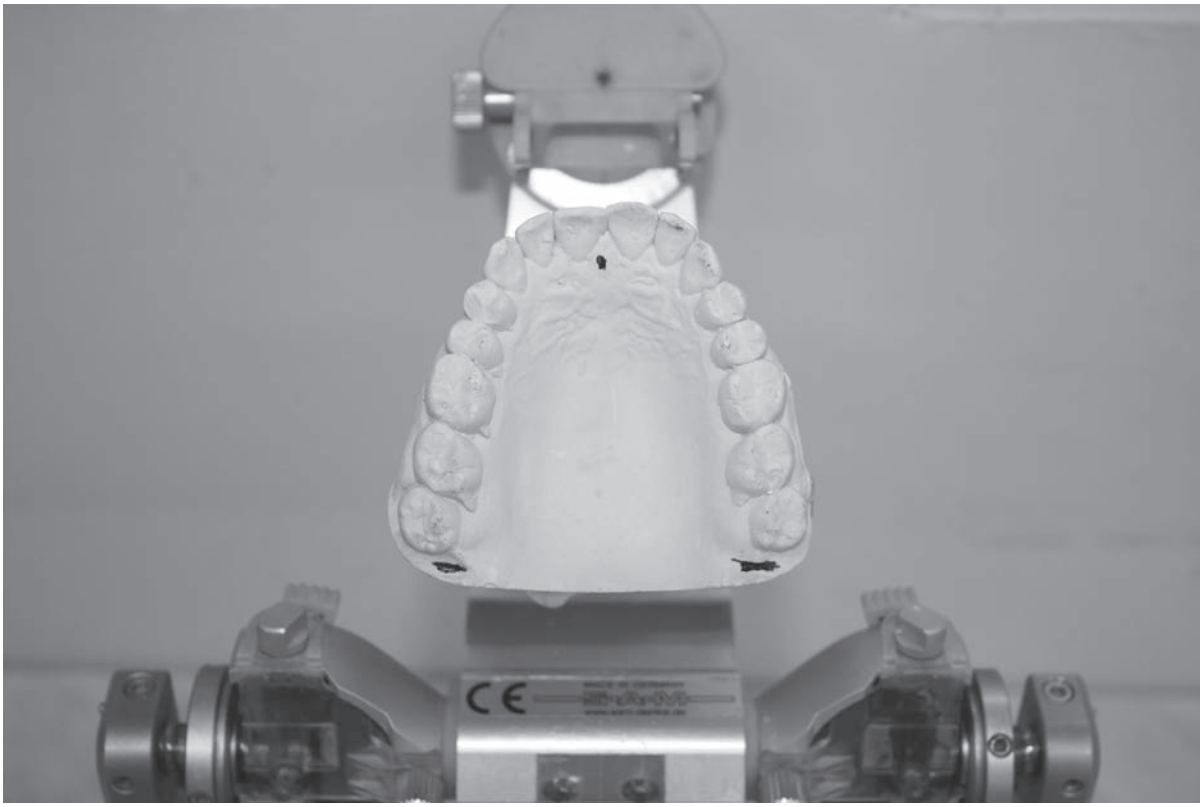

Figure 2. Model of the maxilla with HIP-plane points.

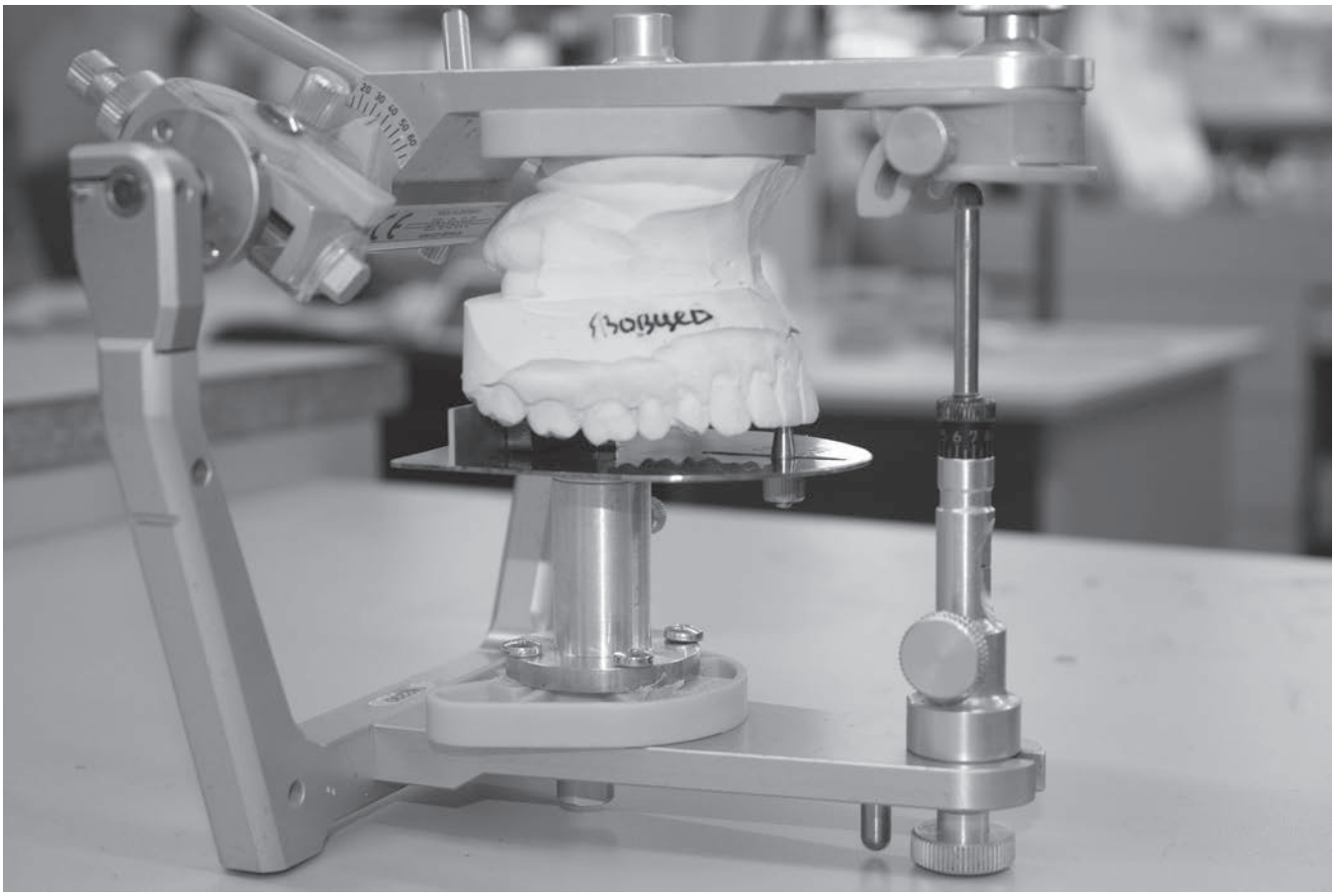

Figure 3. Model of the maxilla is placed in to articulator according to the HIP-plane.

Method of clinical assessment of the position of the upper arch.

To overcome the disadvantages of the described methods, the HIP analyzer, known as the Shestopalov Device, was created. The HIP-analyzer fulfills the idea of this plane's visualization in the patient's mouth. The device consists of an intraoral component, which is in the shape of a horseshoe plate, and connects to a handle *(Figure 4)*. The distal sections of the plate are bent to the side of the maxilla at an angle of 90^0. In the proximal part the plate has a longitudinal slot opening, placed in the middle of the midline, and has a vertically fixed pin that can move along the slot opening. The height of the pin is equal to the height of the distal part of the plate. The handle has an opening where the removable vertical indicating pin is fixed. The device's construction is protected by the Russian Federation Patent №107049 dated 10.08.11.

The standard procedure for the use the HIP-analyzer would be as follows: the device of the necessary size is chosen (the distance between the outward edges of the vertical bends is either M=60 or L=70 mm) and then fixed in the patient's mouth. The vertical parts of the horseshoe-shaped plate must touch the hamulus notches and the vertical pin must touch the incisive papilla. To achieve this, the screw fixing the pin is first slightly loosened. The pin is moved along the longitudinal slot opening, set in the necessary position, and fixed by tightening a screw. By maintaining a slight upright pressure the operator holds the device in the patient's mouth parallel to the HIP-plane. The horseshoe-shaped plate is located slightly below the maxilla dentition. This makes it possible to analyze the maxillary dentition occlusal plane position *(Figure 5)*. It is necessary to remember

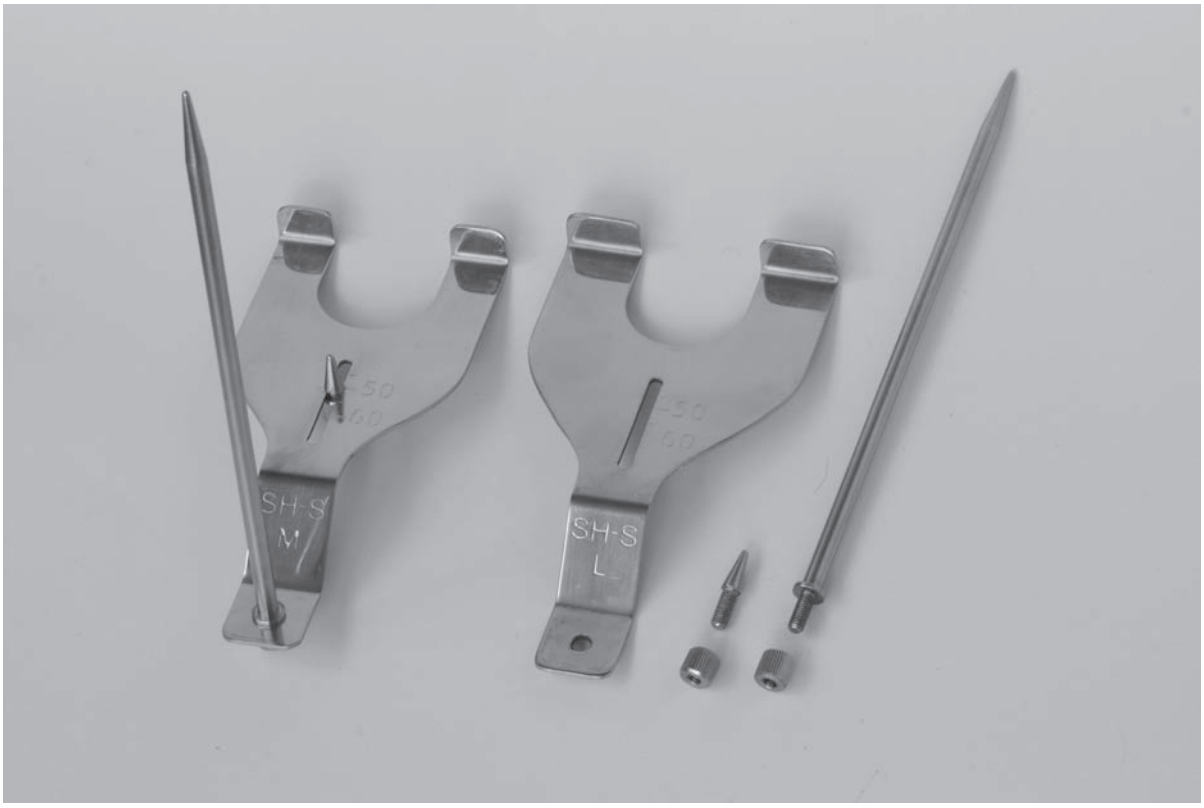

Figure 4. HIP-analyzer.

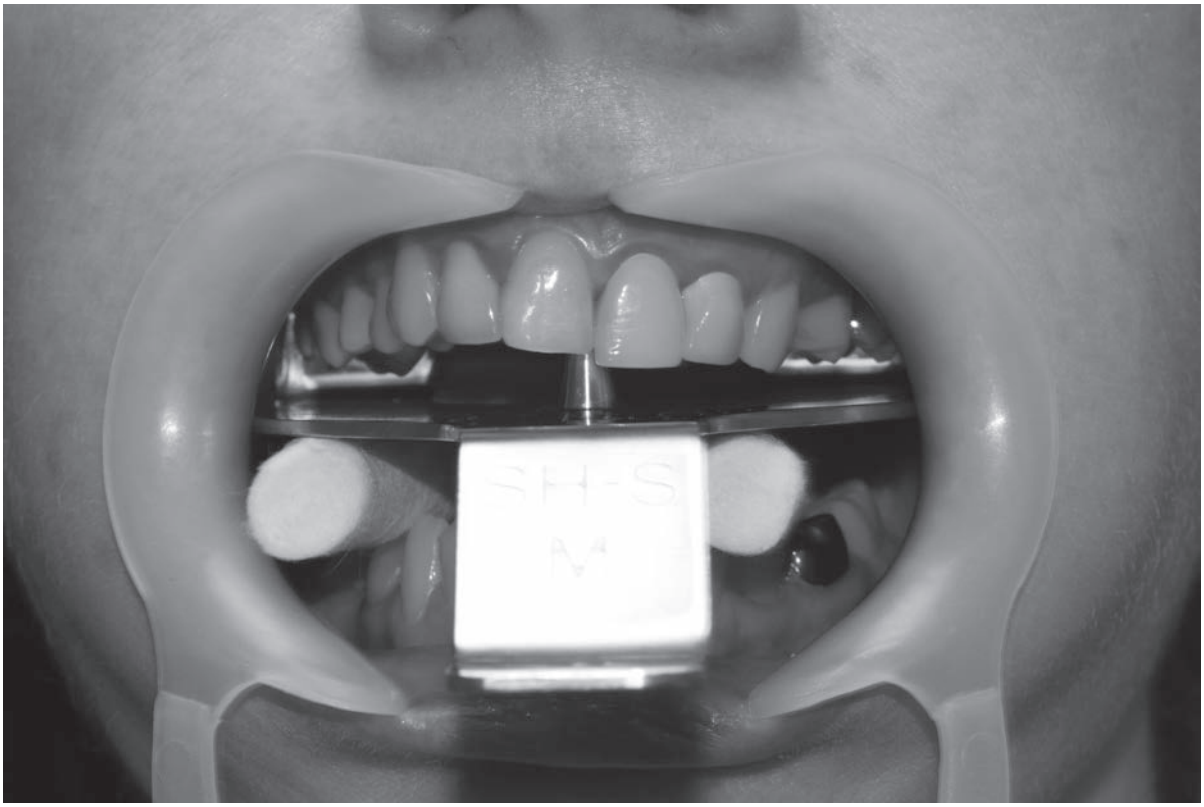

Figure 5. Position of the HIP-analyzer in the mouth.

Figure 6. Vertical indicating pin coincides with the facial midline.

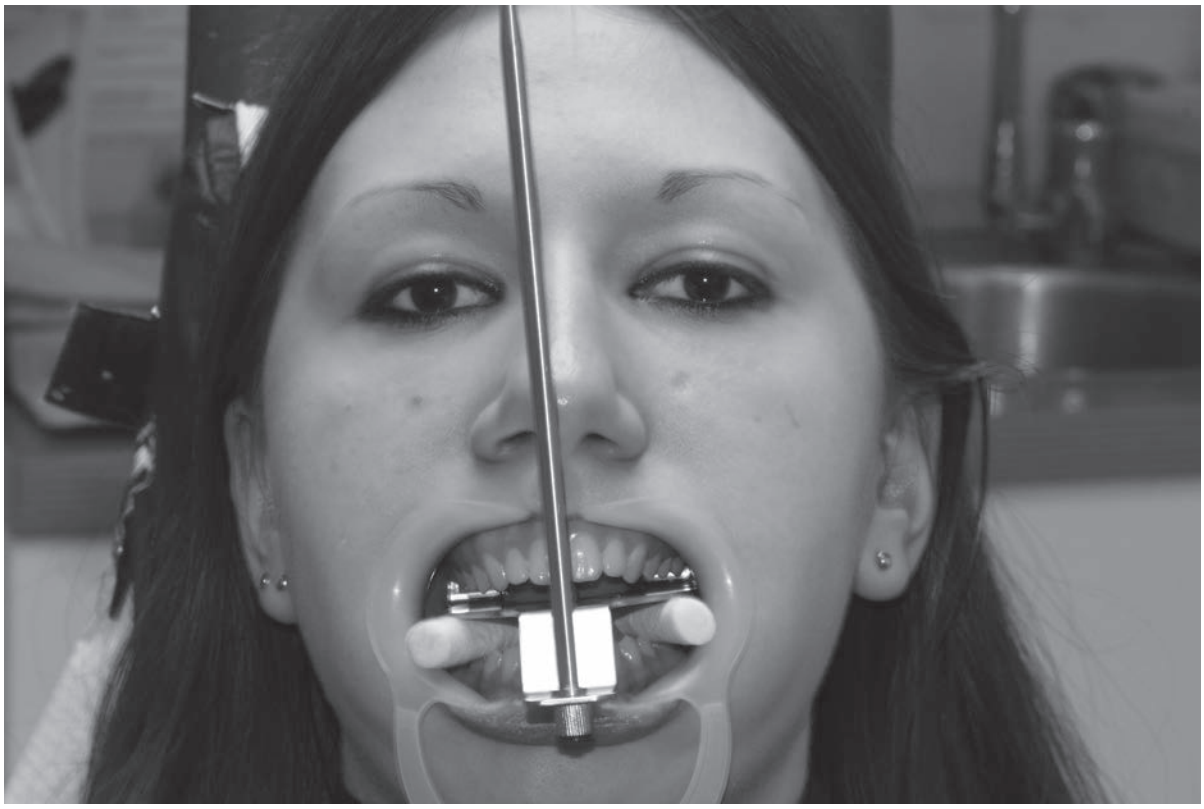

Figure 7. Vertical indicating pin doesn't coincide with the facial midline.

Figure 8. Procedure of getting the silicon-based registrator of the maxilla.

Figure 9. Special mounting table (or HIP-mount) with a longitudinal slot opening.

Figure 10. The silicon-based registrator is placed on the table.

Figure 11. The maxilla model is placed on the registrator.

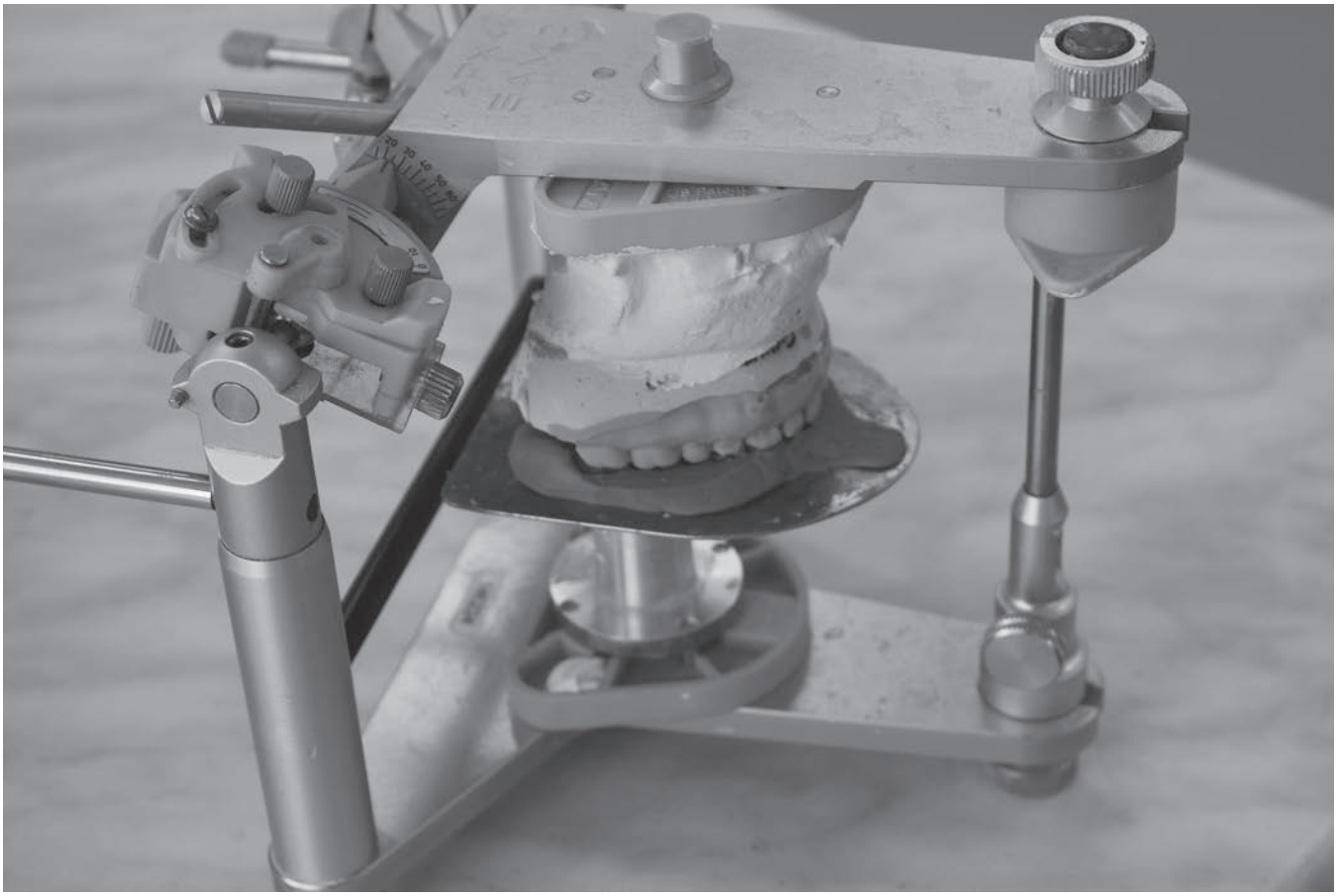

Figure 12. The stone model is mounted to the upper bow (frame) of the articulator.

that the distal parts of the device serve as the support points in the mouth while the pin on the incisive papilla serves only as a contact point. The vertical indicating pin fixed in the handle's opening coincides with the patient's facial midline and serves as an additional orientation point for the proper positioning of the device.

It is necessary to point out that the vertical indicating pin makes it possible to run differential diagnostics between the gnathic (skeletal) and dental-alveolar deformation types of the maxilla dentition at the initial consultation. If the indicator coincides with the midline of the face (centered at 12 o'clock), the position of the maxilla in relation to the base of the skull can be considered symmetrical *(Figure 6);* if it doesn't coincide – the gnathic deformation type can be diagnosed *(Figure 7),* and in this case a more detailed Cephalometric-based diagnostic will be needed. This analysis allows the doctor to collect information concerning the position of the entire maxillary complex and aids in discussing the clinical situation with the patient with regards to esthetics and function.

A method for the transfer of the upper cast in an articulator.

The space between the horseshoe-shaped plate of the HIP-analyzer and the maxillary dentition occlusal surface can be filled with silicon-based material to register the maxilla dentition position in relation to the HIP-plane and can then be sent to the dental laboratory *(Figure 8).* The procedure of getting the silicon-based registrator is analogous to getting one silicon-based impression, and considerably saves time for both the doctor and patient.

The articulator must be equipped with a special mounting table with a longitudinal slot opening identical to that of the HIP-analyzer *(Figure 9).* The silicon-based registrator is placed on the table

(Figure 10), the maxillary model is placed on the registrator *(Figure 11),* after that the stone model is mounted to the upper bow (frame) of the articulator *(Figure 12).* As a result, the HIP-analyzer helps to transfer the maxillary dentition position to any articulator equipped with the table with a longitudinal slot opening without the face-bow.

The silicon-based registrator is the only component that is sent from the clinic to the dental laboratory and it considerably facilitates the communication between the dentist and the dental technician. This process allows for the fulfillment of all of the work in any articulator where jaw models are HIP-plane oriented; this will undoubtedly increase the esthetic and functional value of the fabricated prostheses.

The application of the HIP-analyzer is of special interest in maxilla-facial and orthognathic surgery. Without any anatomical orienting points the dentist can position the device in the mouth, orienting the analyzer in the vertical position of the indicating pin in the frontal and sagittal planes, and then transfer the maxilla dentition position to the articulator with the help of the silicon-based registrator.

Conclusion

1. HIP-analyzer makes it possible to evaluate the topography of the maxillary dentition occlusal plane position, as well as to run a differential diagnosis between the gnathic (skeletal) and dental-alveolar deformation types of the maxilla dentition at the initial consultation.
2. The use of the HIP-analyzer makes it possible to transfer the maxillrya dentition position to any articulator (having a special table) without the face bow.
3. The use of the HIP-analyzer allows for the making of various prostheses according to the orthocranial occlusion, which increases the functional and esthetic value of the prosthetic treatment. Moreover, the device made from the stainless steel is simple to use, is easily disassembled, and is easily sterilized.

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