

Clinical Considerations and Rationale for the Use of Simplified Instrumentation in Occlusal Rehabilitation. Part 2: Setting of the Articulator and Occlusal Optimization



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In fabricating a prosthetic rehabilitation, whether it consists of just a single crown or a complete-mouth reconstruction, one of the main aims of the clinician is to simplify the procedures and reduce the time necessary to integrate it into the mouth of the patient. This article completes the description of the rationale behind the selection of semiadjustable articulators and of a way to transfer to the laboratory technician valuable information that, in the case of extensive rehabilitations, will make occlusal optimization more error free. (Int J Periodontics Restorative Dent 2003;23:xxx-xxx.)

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In part 1 of this article,¹ a rationale was presented for the selection of semiadjustable articulators as adequate and sufficient instrumentation for performing a functional occlusal analysis, determining the changes to be made to the maxillary anterior teeth or the occlusal plane, and fabricating a provisional or definitive restoration that incorporates these changes or includes a large enough number of teeth that it would be impractical to articulate the casts without them. Furthermore, the registration of the spatial position of a patient's maxillary and mandibular arches was described to allow the stone models to be mounted on the articulator.

Part 2 highlights the clinical and laboratory steps necessary to minimize the inevitable differences of these instruments from the masticatory system and to create restorations that will not require extensive occlusal adjustments.



Figs 1a to 1d Cross-mounting the models of the prepared abutments and of the provisional restorations, all at the same vertical dimension and in the same spatial position. Note the custom incisal table generated by the excursive movements of the upper and lower models of the provisional restorations (d).

Cross-mounting models of the provisionals

In extensive rehabilitations or in cases involving the anterior teeth, a great deal of time is often spent determining the optimal form of the provisional restorations from both a functional and an esthetic point of view. It is very important that the information incorporated into the provisionals (tooth shape and length, occlusal plane orientation, overbite, overjet, palatal morphology of the maxillary anterior teeth, angulation of the guiding inclines, vertical dimension of occlusion [VDO], teeth contact) is not lost and is incorporated into the definitive restorations.

Therefore, after having made impressions of the dental arches,

first with the prepared teeth and then with the provisional restorations in situ, further registrations are needed to relate at the same vertical dimension and in the same spatial position the models of the provisionals and those of the prepared abutments. In this manner, the dental technician can use the casts with the provisionals as guides to shape the definitive prostheses (Fig 1). He or she can improve esthetic aspects and use more durable materials, but the technician should not make any changes in the occlusal parameters, since they have already been clinically tested "in the field."

In rehabilitations involving both arches, the impressions to be made are:

- Prepared abutments in the maxillary arch
- Prepared abutments in the mandibular arch
- Maxillary provisionals
- Mandibular provisionals

The corresponding registrations to be made (all at the same VDO and in the same mandibular position) are between: **[AU: OK as edited and separated?]**

- Maxillary abutments and mandibular abutments
- Maxillary abutments and mandibular provisionals
- Maxillary provisionals and mandibular abutments

Each registration is made once, assuming that the operator is certain to be able to guide the mandible in centric relation with reproducibility. Otherwise, it is suggested to make three registrations and check to see if at least two are identical.² At each subsequent step in the fabrication of the definitive prostheses, the position and vertical dimensions are verified.

Cross-mounting the models of the provisionals allows the technician to have two important benefits. First, he or she can visualize the space available on the occlusal and palatal aspects not just statically, but, more importantly, dynamically as well, since the provisional restorations have been functioning and (should) have been successfully integrated in the mouth. (The provisionals are considered successful when they do not break or come

loose, they satisfy the patient's cosmetic requirements, and the patient does not develop signs or symptoms of dysfunction.) Second, the technician can create a customized incisal guide table that will allow recreation of the same disclusion angles present in the provisionals in the final rehabilitation without guesswork (Fig 1d).

Setting the articulator

Before beginning the fabrication of a prosthesis, it is necessary to set the following parameters on a semiadjustable articulator: (1) inclination of the condylar eminence, (2) immediate side shift, and (3) progressive side shift. All three, taken collectively, constitute the posterior or condylar guidance. (For definitions of these and any other subsequent terms, the reader is referred to *The Glossary of Prosthodontic Terms*.³) Whenever the patient's posterior determinants are not identified by means of pantography, the operator has to set the articulator with values that are based upon a sound rationale.

As far as the condylar guidance is concerned, it is important to make sure that it functions together with the anterior guidance to separate the posterior teeth during all excursive movements. This can be achieved by setting the inclination of the condylar eminence on the articulator to be flatter than the one existing in the skulls of the majority of patients⁴: "If the guide is set shallower than the angulation of the patient's eminence, there will be a

greater separation intraorally between the posterior teeth in protrusive movement than that observed on the articulator."⁵

Most semiadjustable articulators have straight rather than convex condylar pathways; this feature can be considered a "safety factor."⁴ The articulator's flat protrusive path will have an inclination that is not as steep as that of the convex articular eminence, especially in its initial portion. Thus, once again, the posterior teeth will be discluded more in the mouth than is evident on the instrument.

As pointed out in part 1 of this article,¹ the temporomandibular joint is made up of structures that have a certain degree of elasticity and are subject to change (due to either functional events or parafunctional forces). It would therefore seem reasonable to introduce a safety factor into the occlusal anatomy of the restoration to be fabricated,⁶ even if one adheres to the view that "an immediate side-shift does not occur when the condyles are fully braced against the eminentiae."^{4,7} To decrease or eliminate the risk that the guiding paths of the balancing cusps might interfere during lateral movements, it is a good habit to set a relatively wide immediate side shift and progressive side shift. The rationale is to set these parameters with a value that puts the operator at an advantage, that is, with a value at or beyond the range found in the majority of patients.

From pantographic tracings recorded on 163 patients, Lundeen and coworkers^{8,9} found that the

Table 1 Values recorded in pantographic tracings of 163 patients^{8,9}

Parameter	Value range	Mean value	Value in 80% of patients
Protrusive path (with respect to axis-orbitale plane, at a point corresponding to 5 mm of protrusive movement)	25–75°	45°	30–60°
Mandibular immediate side shift	0–3 mm	0.75 mm	0–1.5 mm
Mandibular progressive side shift	7°	7°	7°

average condylar inclination is 45 degrees, the average amount of immediate side shift is 0.75 mm, and the average angle of the progressive side shift is 7 degrees (Table 1). For the immediate side shift, other authors found values ranging from 0 to 2.4 mm.^{10–14} Thus, the arbitrary values suggested for the articulator are:

- Condylar inclination: 20 to 25 degrees (with respect to the arbitrary reference plane previously described¹)
- Immediate side shift: 1.5 mm
- Progressive side shift: 10 degrees (some articulators incorporate this value in the customized condylar fossae provided)

The antagonist

In cases where the teeth of only one arch are involved in the rehabilitation, it is very important to pay attention to how the impression and cast of the opposing arch are made.¹⁵ Generally, the materials employed

for these impressions are irreversible hydrocolloids, reversible hydrocolloids, and elastomers. The first two materials need to be poured immediately, while elastomers can wait for several days. For all of them, it is recommended to use their respective tray adhesives, thus minimizing the risk of separation or plastic deformation, which will result in an inaccurate cast.

Regardless of the impression material used and the laboratory material in which it is poured, it is a delusion to think that the resulting model is an exact duplicate of the patient's mouth. There will be differences between the stone (or resin) model and the patient's arch: The model is solid, with teeth that cannot move in any direction, while, clinically, the periodontal ligament, alveolar processes, and maxilla and mandible proper are elastic and allow vertical and lateral movements of the teeth. For example, the mandible's width decreases during opening and protrusive movements up to 0.5 mm at the second molar level.¹⁶ Furthermore, there are other

reasons the situation on the articulator may differ from that in the mouth¹⁷:

- Distortion of the impression material
- Stone expansion (or resin contraction)
- Defects on the occlusal surfaces (voids or air bubbles)
- Distortion of the intermaxillary registration material
- Insufficient adaptation of the intermaxillary registration material to the models

This results in an intercuspation of the two models that does not replicate that found intraorally^{17,18} (Fig 2). One way to compensate for this problem is to precisely record on the lab prescription form the occlusal contacts found in the mouth with an 8- to 15- μ m shimstock articulating paper. Once the models have been mounted, the technician has to verify whether the contacts on the articulator match those found in the patient. If they do not, as happens in the majority of the cases, the technician must perform an occlusal adjustment of the models before beginning fabrication of the prostheses (Fig 2). If this "trick" is not adopted, when trying in the prostheses the clinician will often find that they are high in occlusion and much time will be wasted in adjusting them until the proper vertical dimension is regained.¹⁸ At the same time, the technician must be careful not to overdo the occlusal adjustment; otherwise, the prostheses will be found to have no occlusal contacts.

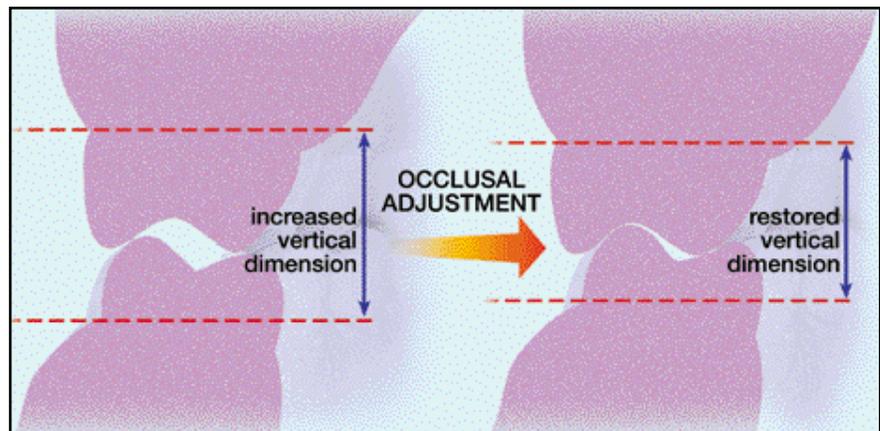


Fig 2 Left: Exaggerated representation of the increase in vertical dimension when stone models are initially mounted. Such an increase usually is not perceived by the operator who is not aware of all the variables that contribute to this problem. Right: After a carefully carried out occlusal adjustment, the patient's original vertical dimension is restored prior to the fabrication of the prosthesis.

Conclusions and recommendations

On the basis of the rationale proposed in parts 1 and 2 of this article, the following conclusions are drawn and recommendations made by the author when performing the procedures in preparation for a prosthetic rehabilitation:

1. In an extensive rehabilitation, if esthetic landmarks as well as information about the anterior guidance developed need to be transferred, models from impressions of the provisionals should be made and cross-mounted with the models of the prepared abutments.
2. Semiadjustable articulators should be set with values that are designed to create a safety factor: a relatively flat condylar

guidance and a relatively large lateral play.

3. In cases where the patient's maximum intercuspation position has been selected as the intermaxillary position, it is important to perform an occlusal adjustment on the mounted models prior to fabricating the prostheses to identify on the articulator the same occlusal contacts found in the mouth.

As stated by the American Dental Association's Council on Dental Materials and Devices, "The articulator, simple or complex, is only an instrument that assists the dentist to apply his wisdom and skill to a clinical problem . . . the dentist using the articulator is the critical factor in the successful application of these devices in clinical dentistry"¹⁹ (Fig 3).



Fig 3a This 30-year old woman (see Fig 1) underwent complete-mouth rehabilitation because of the extensive enamel destruction caused by a lemon-sucking habit that lasted several years and the need to replace several defective restorations.



Fig 3b Four-mm vertical dimension increase (in the anterior) is tested by maintaining the patient in provisionals for about 1 year.



Fig 3c (left) Waxup of the definitive restoration obtained after cross-mounting the models of the preparations with those of the provisionals (Fig 1).

Fig 3d (right) Definitive restorations reproduce the functional aspect of the provisionals.



Fig 3e (left) Definitive restorations after cementation.

Fig 3f (right) Clinical appearance after completion of the prosthetic rehabilitation: All posterior crowns are in metal ceramic, while the anteriors are in Empress (Ivoclar).





Fig 3g Patient at the 4-year recall.



Fig 3h Radiographic situation at the time of delivery of the prosthesis.

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