The ABCs of Occlusion & Articulation

Reducing Positive Errors for Less Adjustments

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Introduction

This article will focus on the ABCs (Axis, Bite, and Chewing) of Occlusion and Articulation that can be easily implemented to create restorations that require less adjustments, saving time and reducing stress. The initial step in reducing positive errors in articulation begins with accurate impressions and bite records as any error in the technique or material will create a high restoration. All philosophies have the same objective of equal contacts of the occluded teeth with no interferences in all movements. Laboratory technicians can achieve this objective on whatever articulator they may use, yet most restorations still need adjustments when placed in the patient's mouth because of inaccurate impressions and/or positive errors in the Axis, Bite and Chewing.

An articulator is an instrument that represents the temporomandibular joints (Axis) or jaws to which study casts may be attached to simulate the static (Bite) and dynamic (Chewing) relationship between the occlusal surfaces of the teeth during mandibular movements. Positive Errors occur when the articulator undercompensates for mandibular movements, resulting in a positive feature on the occlusal surface where that feature should be smaller or nonexistent.[11] Positive Errors can create interferences that may need to be adjusted in the Axis (opening and closing movements), the Bite and Chewing (envelope of function movements) depending on the discluding factor of the protrusive pathway, influence of Bennett movement, and steepness of the anterior guidance. Negative Errors occur when the articulator overcompensates for mandibular movements, resulting in a negative feature on the occlusal surface which allows the teeth to disclude more freely. [11]

Axis

It is important to relate the teeth to the patient's axis to simulate more accurate axis movements in an articulator. The most common error in relating study models is using a simple hinge articulator without the use of a facebow. The axis in simple hinge articulators (Fig. 1, red point B) are always located below the patient's axis (Fig. 1, green point A). Therefore, simple hinge articulators produce more vertical opening and closing axis movements (Fig. 1, red pathway b) than the patient's opening and closing axis movements (Fig. 1, green pathway a). This positive error in axis movements can create interferences in the mesial inclines of the upper teeth and/or distal inclines of the lower teeth that will require adjustments.[1]

Research shows that a facebow has a statistical average to the axis by referencing the patient's ears which relates the study models much closer to the patient's axis to reduce

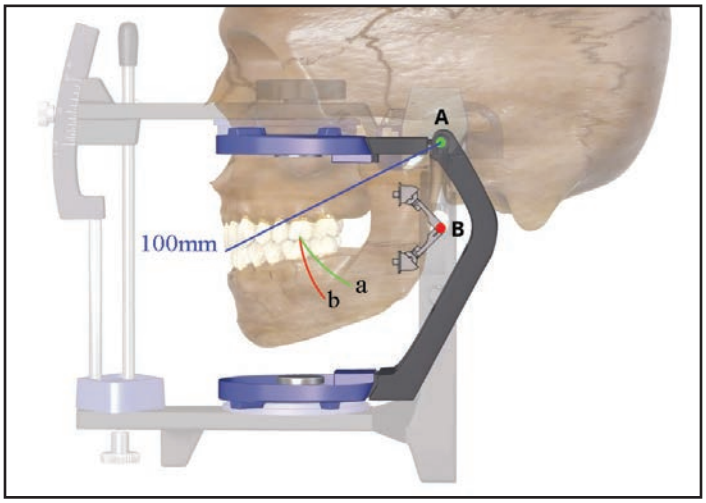

Figure 1

Figure 2

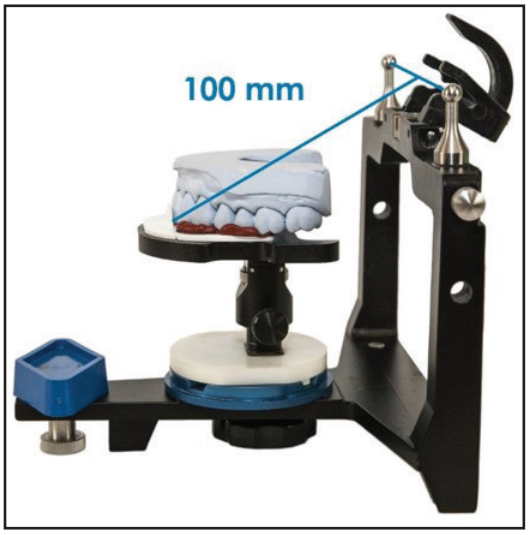

Figure 3

positive errors.[2] The Kois Dento-Facial Analyzer (DFA) is a simple instrument that incorporates a 3-Dimensional guide plane to reference how the occlusal plane relates to the face for esthetics, as well as having a functional relationship of the teeth to the axis based on an average axis-incisal distance of 100mm (Fig. 2).[3] This 100mm axis-incisal distance is supported by Monson's Spherical Theory (4in=101.6mm)[4], Bonwill's Equilateral Triangle[5], as well as other research showing the Kois DFA to be as functionally accurate as a facebow.[6,7] The 100mm axis-incisal distance is also engineered into the Kois Platform on the articulator which can mount study models with or without the use of the Kois DFA (Fig. 3).[3]

Step 1:

Assemble the Kois DFA and add bite registration material to the Kois Index Tray. Insert Kois DFA into patient's mouth and place the vertical wall on Kois Index Tray to the facial of central incisors (Fig. 4). This will register and transfer the central incisal edge, of the 100mm axis-incisal distance, for function.

Step 2:

Align vertical rod to the patient's facial midline and level the lateral wings (Fig. 5). Keeping the vertical rod and lateral wings aligned, push up lightly until a tooth touches the tray and then hold until material sets. This will register and transfer any cant of the occlusal plane related to the horizon and facial midline for esthetics.

Step 3:

The Kois Index Tray is indexed to the Kois Adjustable Platform on the articulator and the upper study model is esthetically orientated into the impression on a horizontal Kois Index Tray with the incisal edge 100mm from the axis of the articulator for function (Fig. 6). Mount study models to the articulator in usual manner.

Step 3 Option:

For a Standard Functional Mounting, simply place upper study model on the Kois Platform with the incisal edge to the 100mm line on the waxing guide (Fig. 7) (New PAL 2.0 Articulator System shown).

The Panadent PAL 2.0 Articulator System with integrated Kois Platform has same anatomical axis as the full-size articulator and is designed to implement the ABC's of Occlusion for General or Digital Dentistry (Fig. 8)! Using the Kois DFA to communicate esthetic and functional information or doing a Standard Functional Mounting using the Kois Platform may reduce positive errors for less adjustments of opening and closing movements of the Axis.

Bite:

All dentists use marking ribbon to mark and adjust any high spots to achieve equal contacts of the teeth when the patient bites (MIP). However, if the patient has worn or broken teeth, periodontal disease, muscle or TMD dysfunction, then the patient's bite (MIP) in relation to their jaw position may not be working well and maybe one should consider changing the bite to a new jaw position.

- Maximal Intercuspal Position (MIP): the best fit of the

Figure 4

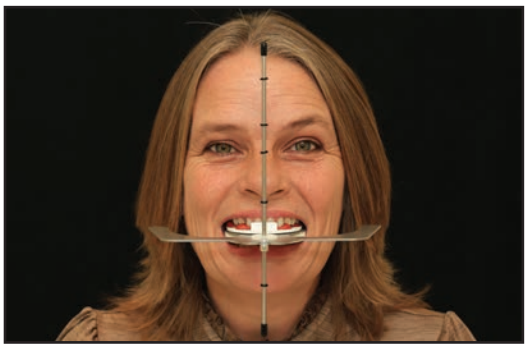

Figure 5

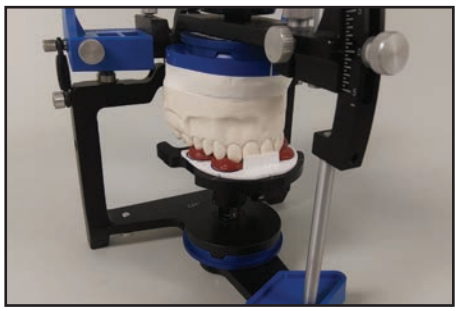

Figure 6

Figure 7

Figure 8

teeth regardless of condylar position.

- Centric Relation (CR): a maxillomandibular relationship independent of tooth contact.
- Centric Occlusion (CO): the occlusion (first contact) of opposing teeth when the mandible is in centric relation.

It makes anatomical sense to have the jaw in a physiologic position where the condyles are against the disc orthopedically aligned in the fossa when all the teeth are occluded (CR+MIP=CO) with normal neuromuscular function (Fig. 9). It is important to confirm that the Centric Relation jaw position is a comfortable, stable, and repeatable position. This should involve the use of an orthotic device that incorporates an anterior deprogrammer (something between the anterior teeth) which separates the posterior teeth, relaxes the muscles, and allows the condyles to seat upward and forward against the disc in the fossa (Fig. 10). The orthotic device can be adjusted periodically as healing and remodeling occurs until the TM Joints have stabilized. Methods for registering a CR interocclusal record usually incorporates the use of an anterior discluder such as a Lucia Jig, leaf gauge, etc.

Since the articulator axis is not the true hinge axis of the patient when using a facebow or Kois DFA, changing Vertical Dimension of Occlusion (VDO) on the articulator can create positive errors or discrepancies in the Bite. When changing VDO, it is highly recommended to take an interocclusal record at the VDO that the restorations, prostheses, or occlusal splint will be fabricated to reduce positive errors for less adjustments of the Bite.

Chewing:

It is important to understand incising and lateral chewing movements (envelope of function) to simulate more accurate chewing movements in an articulator. The protrusive pathway (downward and forward movement of the condyles) together with incisal guidance can have a discluding influence on the distal inclines of the upper teeth and/or mesial inclines of the lower teeth in incising chewing movements (Fig. 11). Research shows that the angle of the protrusive pathway ranges from 25° to 75° to an axis-horizontal plane of reference. The protrusive pathway is the only discluding factor that can be programmed into an articulator which can be communicated with a protrusive interocclusal record to set the articulator. If no protrusive record is taken, it is recommended to set the articulator to a 25° protrusive pathway to create negative errors in incising Chewing movements.

The Bennett movement (inward movement of the condyles) together with canine guidance can have a discluding influence on the buccal and lingual cusps of

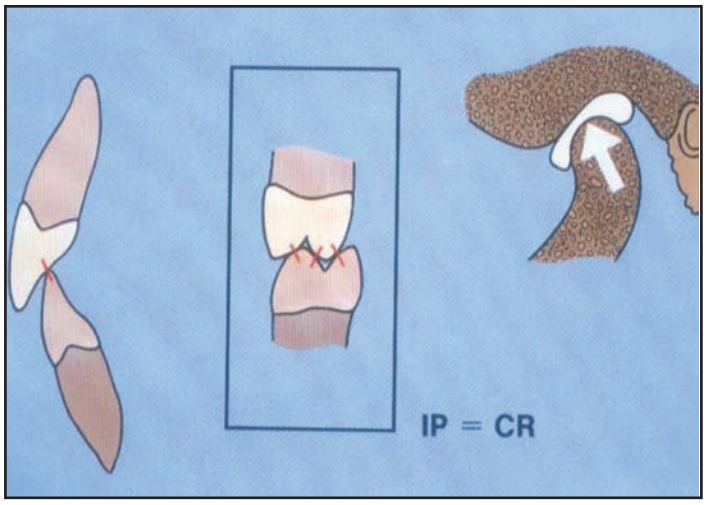

Figure 9

Figure 10

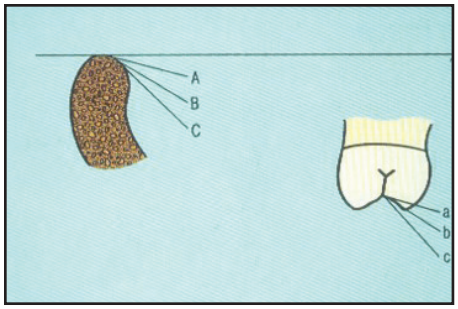

Figure 11

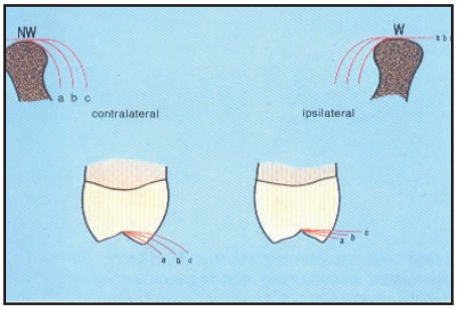

Figure 12

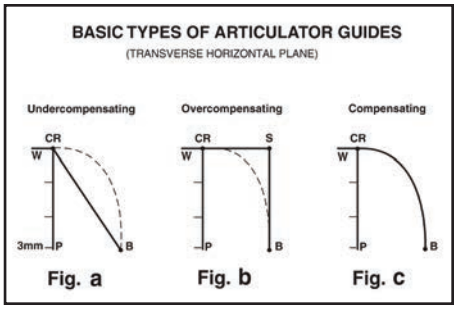

Figure 13

the posterior teeth in lateral chewing movements (Fig. 12). Research shows that Bennett movement ranges from 0.5mm to 2.5mm with approximately 90% of the population having 1.5mm of Bennett movement or less.[8] It is recommended to set the articulator to at least 1.5mm of Bennett movement to create negative errors in lateral Chewing movements.

Most semi-adjustable articulators incorporate a straight-line undercompensated Bennett guide "a" (Fig. 13), meaning the patient can move (curved dotted line) beyond the articulator guide (solid line) which may create positive errors in lateral chewing movements. The "Immediate Side Shift" articulator incorporates an overcompensated Bennett guide "b" (Fig. 13), meaning the articulator can move (solid "S" lines) beyond the patient's movements (curved dotted line) which may create negative errors, but may also produce flatter anatomy. The Panadent articulator incorporates a curved path compensated Bennett guide "c" (Fig. 13), meaning the articulator moves more like the patient's jaw movements which may reduce positive errors for less adjustments in lateral Chewing movements and still allow for good anatomy.[9,10]

Summary:

A. Using the Kois DFA or doing a Standard Functional Mounting to relate the teeth to an average anatomical axis may reduce positive errors for less adjustments in opening and closing movements of the Axis.

B. Taking an interocclusal record at the Vertical Dimension of Occlusion you want to be restoring to may reduce positive errors for less adjustments of the Bite.
C. It is recommended to set the articulator with a 1.5mm Bennett movement and a 25° Protrusive pathway to produce negative errors for less adjustments of incising and lateral movements of Chewing. ■

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Thomas Lee is the President of Panadent Corporation, a company dedicated to providing quality innovative products and exceptional customer service to the dental profession since 1974. Mr. Lee is the son of Dr. Robert Lee, who published his research on "Jaw Movements Engraved in Solid Plastic for Articulator Controls" in the JPD 1969 which led to the development of the Panadent Articulator System. Mr. Thomas Lee holds several patents on face bow and articulator design and methods. Being involved with top clinicians and the dental profession for over 35 years, Mr. Lee has published several articles and has lectured nationally and internationally with his extensive knowledge in articulator design and its relationship to occlusion and esthetics.