Condylar Angle Programming: The “Missing Link” in Diagnostic and Restorative Dentistry

by Michael J. Melkers, D.D.S., F.A.G.D.

Dr. Melkers is a 1994 graduate of Marquette University School of Dentistry. He and his wife, Dr. Jeanine McDonald, practice general dentistry in Spokane, Washington, with an emphasis on comprehensive and restorative care. A clinical faculty member and presenter in PAC-Live’s Ultimate Occlusion Program, Dr. Melkers has presented in the United States, Asia, and Mexico on occlusion issues, full-mouth rehabilitation, doctor-ceramist communication, and direct composite sculpting. He also has provided hands-on programs on occlusion, splint therapy, articulation, and direct composite artistry. He has developed a Broadrick Flag adaptation for the KaVo Protar articulation system, has been involved with modification and implementation of the Arcus Digma (KaVo Dental; Lake Zurich, IL) in the United States, and continues to work with several companies on product evaluation and development. Dr. Melkers has no financial interest in any of the products discussed in this article. He can be contacted at info@MichaelMelkers.com.

The accuracy of diagnosis, treatment planning, and delivery of that treatment can be greatly affected by the accuracy of the records, as well as by the diagnostic and treatment instruments. Even the most meticulous diagnosis can be rendered inaccurate if the instrumentation on which it was based does not accurately represent the conditions that are present in the patient.

Even the most meticulous diagnosis can be rendered inaccurate if the instrumentation on which it was based does not accurately represent the conditions that are present in the patient.

RATIONALE FOR APPROPRIATE INSTRUMENTATION

When choosing appropriate instrumentation for the procedure, the practitioner must not only consider the goal of treatment, but also the treatment path that will be required to achieve that goal. The case’s specific needs should dictate the appropriate instrumentation for treatment. The benefit of the accuracy of the instrumentation must be weighed against the treatment time involved. Assuming that the practitioner can achieve the desired treatment result, the most efficient
instrumentation is the most logical choice as a treatment tool.

In his classic textbook, Dr. Jeffrey Okeson graphically illustrates the conceptual advantage of the nonadjustable, semi-adjustable, and fully adjustable articulators (Fig 1). The lower area of the graph is indicative of the ability of each type of instrument to provide conditions that assist in meeting our treatment goals. In other words, the ability of the instrumentation to mimic the static positions as well as motion paths that exist in the oral environment in such a way that is beneficial to the treatment outcome.

The upper bar of the graph, again conceptually, illustrates the intraoral adjustments the clinician needs to achieve the treatment goals. That is to say, the adjustments that would be required due to the inability of the articulator to mimic the conditions that exist in the intraoral environment of the patient.

The information missing from the above example relates to the specific characteristics of the case. How complex is the case? Is it a full-mouth rehabilitation? Is it an anterior smile makeover? Perhaps the case is only a small occlusal inlay. It is the responsibility of the practitioner to be familiar with the benefits of each system so that they can choose the appropriate system for the requirements of each specific case. The small occlusal inlay may be fabricated to clinical excellence using only a triple tray type impression mounted on a nonadjustable hinge-type articulator. On the other end of the spectrum, the time required to mount a full-mouth rehabilitation case on a programmed semi- or fully adjustable articulator for diagnosis, treatment planning, and treatment would be a wise investment, considering the considerable intraoral adjustments that would be required if this investment were not made.

**The Triad of Articulator Programming**

To achieve the accuracy and thus the value of instrumentation in diagnostic and restorative procedures,
practitioners should be aware of the basic components of instrumentation programming and the rationale for each. As Dr. Michael Buonocore eloquently stated, “Methodology without rationale is like memory without understanding…” We must understand each component and its purpose in diagnosis and treatment if we are to evaluate the appropriate indication for each in practice.

**FACEBOW TRANSFER**

The first component of the triad is the facebow record transfer. This record is the foundation upon which the additional components of the triad are based and made accurate.

**CENTRIC RELATION RECORDING**

The second component of the triad is the recording of the intraocclusal relationship. While it is possible to record the relationship of the maxilla to the mandible in a variety of positions, it is logical that the most desirable recording should be taken at a stable and reproducible position. That position is centric relation (CR), which should be recorded in an open bite position, to remove any deflective influence of the dentition on the accuracy of the bite registration.

Together, the first two components of the triad allow the practitioner to accurately mount the upper and lower casts along the hinge axis of CR (Fig 3).

**THE “MISSING LINK”**

While a facebow transfer record and CR bite registration can provide a very accurate representation of the relationship of the upper and lower jaws along the hinge axis, one of the greatest advantages of semi-adjustable instrumentation has not generally been utilized. The greatest strength of semi-adjustable instrumentation is the ability to quickly...
and accurately program the instrument for functional and parafunctional excursions.

With condyle-disk assembly positioned in the most superior position against the eminentiae, the condyles may rotate on a fixed axis while maintaining the CR position (Fig 4). This type of movement will affect the vertical dimension of the relationship of the maxilla to the mandible in opening and closing motions. As the condyle moves out of CR it begins its rotational and translational path down the eminence (Fig 5). The resulting movement observed in the inter-jaw relationship may be lateral movement; protrusive movement; or a laterotrusive combination of the two, depending upon the extent of condylar movement and whether bilateral or unilateral condylar movement is involved.

The greatest strength of semi-adjustable instrumentation is the ability to quickly and accurately program the instrument for functional and parafunctional excursions.

In a protrusive movement, the condyles translate down the eminence, traversing through the x-axis (superior-inferior), the y-axis (medial-lateral), and the z-axis (anterior-posterior). As this three-dimensional movement occurs in condyle, it also occurs simultaneously in the bodily movement of the mandible. This influence of the condylar path upon the mandibular position can therefore be recorded through the use of an intraocclusal registration in a mandibular protrusive posture.

REGISTRATION AND TRANSFER OF THE PROTRUSIVE RECORD

As the condyle reaches its terminal position at the inferior-anterior extent of the eminence (Fig 6), the practitioner will observe in most dentitions an anterior end to end, or slightly past end-to-end posture. At this position, using either softened extra-hard baseplate wax or a
Figure 10: Adjusting the inclination angle of the eminence.

Figure 11: Corrected angle with the condyle in contact with the eminence.

Figure 12: Clinical excursion.

Figure 13: Properly programmed excursion on articulator.

Figure 14: Clinical protrusion.

Figure 15: Properly programmed excursion on articulator.
semi-rigid bite registration material, the intraocclusal relationship can be recorded (Fig 7). For stability of the record transfer, it is important that this record extend to include as many occlusal and incisal registrations as possible.

After allowing the registration to fully harden, the record is transferred to the laboratory for programming of the facebow-CR-mounted models. After releasing the condylar locks on the articulator, the protrusive record is placed on the models and fully seated (Fig 8). At this stage, the practitioner or laboratory technician may observe the condylar head replica off of the eminence slope of the articulator (Fig 9). At this point, if the condylar head is in contact with the eminence, it may be interfering with the complete seating of the models in the protrusive record.

In either of the two scenarios, the condylar angle pathway locks should be released so that the condylar angle may be adjusted without resistance. With the casts now fully seated in the protrusive registration, the eminence slope of the articulator can be rotated (Fig 10) until contact is made with the condylar head replica of the articulator (Fig 11). The condylar angle pathway locks should be reengaged and the condylar angle noted. The condylar angle pathway programming is now complete.

### Clinical Accuracy of Condylar Angle Programming

The accuracy of the mounted models and condylar angle programming can be observed by comparing the eccentric movements as they present in the patient and on the articulator. The patient in this case was instructed to move their mandible to one side (Fig 12). As this position is compared to the same directional excursion on the mounted programmed models (Fig 13), excellent clinical accuracy is noted. The intercuspsation of the cuspids and lateral incisors appears to have nearly identical positioning between the two excursive movements. Viewed from the anterior, the clinical and mounted model excursions present a similar level of accuracy (Figs 14 & 15). The location of the guiding contacts is accurate, not only in regard to which tooth is in contact, but also as to the precise area of the incisal edges that are providing the guidance.

### The Consequences of Inaccuracy

Questions such as the following frequently arise when discussing articulation and occlusion: “Is condylar programming even necessary?” or “Aren’t average values good enough?” These questions can be condensed to, “Is there an adverse consequence if the condyles are
Average values do have their basis in reality but they are by definition an “average.” Research has confirmed that although the majority of condylar path angles charted fall within what are considered “average values,” 46% of the measurements did not, with a wide distribution (Fig 16). Simply stated, nearly half of the condylar measurements recorded do not fall within the definition of average values. The next question to be addressed is, “Is this significant?”

Using the same set of mounted models, the condylar angle setting has been changed to 30° Camper’s, which falls within the range of the previously noted average values. When the altered programmed articulation is observed in the same lateral excursive movement (Fig 17), a significantly altered position is noted. The guidance of the upper cuspid has distalized off of the lower lateral incisor and is borne exclusively by the lower canine. Further alteration of the condylar programming to an angle that might be present in a nonadjustable hinge articulator (15° Frankfurt/0° Camper’s) alters the guidance even more significantly (Fig 18). The altered guidance has been transferred on the mounted models to the contralateral second molar.

Either of the above altered scenarios has the potential to adversely affect the accuracy of the data provided by the models. For diagnostic purposes, this could lead to inappropriate treatment planning and, in turn, treatment. In actual restorative treatment, the inaccuracy of the models could lead to guidance built into restorations that would require extensive intraoral adjustments, or even potential refabrication of the restorations.

**CONCLUSION**

While no instrument can truly replicate the movements of the jaw in function and parafunction, condylar programming is a simply executed procedure that can provide clinically relevant, invaluable information for both diagnostic and restorative procedures. The minimal time that is involved in articulator programming can far outweigh the potential for misdiagnosis, treatment planning, and restorative care if the procedure is not performed. Practitioners should be encouraged to utilize this valuable procedure as an enhancement to their diagnostic and restorative procedures.

**ACKNOWLEDGMENT**

The author thanks Dr. Greg Tarantola and Jeff Thibadeau for their enthusiasm and commitment to the procedures discussed in this article.

**References**

4. Ibid., p. 29.