Computerized jaw tracking
The technology of the future

By Burt Rufenach, DD

Tooth manufacturers today produce teeth with cusp angles ranging from 0 degrees to more than 30 degrees. Selecting the right degree of tooth can depend on several factors, but the most important is the movement of the patient’s mandible as guided by the TMJ. With so many options available to the denturist, how can we be sure that we are selecting the correct cusp angle of tooth for each patient? How can we obtain accurate and consistent jaw records for the construction of a prosthesis that will function in harmony with the patient’s specific jaw movements?

Let’s examine a few current ideas in denture occlusion. Some lower ridges are severely resorbed and a 0-degree cusp tooth should keep the lower denture more stable during the lateral movements of mastication. Some lower ridges are quite large and much less resorbed, but, does this mean that a 30-degree cusp tooth should be used on un-resorbed ridge? Our professional knowledge tells us that this is not necessarily the reason for selecting a shallow or steep cusped tooth. Do 0-degree teeth give a patient less sore spots than steep cusped teeth? If this was true, then teeth with steeper cusps should be phased out of our pro-

sion use. Do steep cusped teeth chew better that shallow cusped teeth or are teeth set up in a lingualized occlusion the answer to stability? How would a 0-degree tooth that is set up with an occlusal curve compare in mastication to a cusp tooth set up to a flat plane of occlusion?

Cusp angle has much to do with the movement of the mandible as guided by the TMJ. The condyle angle and bennet angle in conjunction with cuspal guidance directs the mandible’s movement. The mandible’s angular movement has measurable angles in relation to the plane of occlusion. These angles can be measured and should allow you to make a more meaningful choice when selecting a steep or shallow cusped tooth. With a steeper condyle angle, you should use a steeper cusped tooth and with shallow condyle angle, a shallow cusped tooth will function in harmony with the mandible’s natural movements.

Conventional methods of obtaining condyle angles, bennet angles and cuspal guidances has for very many years been done using a mechanical...
device called the face bow. Its accuracy rests in the ability of the practitioner to manipulate the device precisely and consistently. Patient manageability is a factor with a sometimes awkward, complex and time-consuming mechanical device that can be very uninviting to some patients. Should condyle and bennet angle differ significantly from the left glenoid fossa to the right glenoid fossa as exists in some patients, the skill of the practitioner can be quite taxed to obtain the correct results.

Welcome to the new evolution in computer technology designed to calculate the precise computerized jaw tracking devices known as electronic face bows, which can track the many aspects and variations of mandibular movement. KaVo’s computerized calculations claim an accuracy of plus or minus 2% for all its angle calculations. The upper model is mounted with the use of a bite fork holder, eliminating the use of a face bow transfer. KaVo’s system is an articulator-related registration technique and requires the use of a KaVo PROTAR articulator. During the measuring time, this articulator is “virtually” projected into the mouth of the patient.

During the measurement, the PROTAR articulator is “virtually” projected into the skull. This is possible, because all dimensions of the articulator (e.g. intercondylar distance, the distance between the bite fork and the condyles) are known by the ARCUS Digma software.

A possible articulator is when done in conjunction with ARCUS KaVo’s Protar 5B, a very sophisticated yet easy-to-use articulator including adjustable Condyle- and Bennett angles. Moreover all other adjustable KaVo articulators as the PROTAR 7 or 9 can be used as well. KaVo’s system is an articulator-related registration technique and requires the use of a KaVo Protar articulator. The actual measuring time to take condylar readings can take five to 10 minutes excluding the preparation time. The measurements obtained in this short time are astounding. It calculates condyle angles and bennet angles for both left and right sides. It measures incisal guidance, left and right cuspal guidance. Immediate side shift and side shift angle are also calculated should these measurements have meaning in your practice.

Another function of this computer can perform is the EPA test (electronic position analysis). It can compare various bites to each other. For example, it could compare a habitual centric bite to centric relation, or compare a correct bite to an incorrect bite and display the comparison three dimensionally in 0.3 mm increments. This is very useful when inserting an implant-supported denture where a very correct bite is most important. The EPA test is also useful in determining a splint position or checking a splint’s accuracy.

Moreover the tabletop Arcus Digma unit can store up to 12 seconds of mandibular movement and replay or stop at any point of movement for analysis. Accelerations, delays or asymmetrical mandibular movement can be viewed three dimensionally. TMJ dysfunctions can be viewed for evaluation. Arcus Digma has other specialized computer functions that have specific diagnostic applications for highly trained dental specialists that specifically treat TMJ dysfunctions.

The two Arcus Digma systems consists of a self contained computer with a colour touch screen (tabletop unit) or a two
“For more ease, the whole program can be controlled with a foot control, freeing up your hands completely.”

colour screen (handheld), a head bow, a pair of ultrasonic transmitter-sensors that attach to the mandible with a small device called a paraocclusal clutch and to the maxilla with a bite fork. This lightweight hardware does not clutter up the patients face and leaves the practitioner free to operate as normal with out any confinements.

For more ease, the whole program can be controlled with a foot control, freeing up your hands completely. The touch-screen module is connected to a small printer or can be interfaced directly to your office computer for data storage. The whole system is small enough to take from one office to another, especially the Arcus Digma Handheld offers a lot mobility by using a battery operation and a smaller size.

Arcus Digma does not conflict with any bite registration method whether you are using wax bite rims, a pin tracing technique or a non-conventional system like the Acculiner’s method of determining a plane of occlusion. As long as you can connect the electronic sensors to the occlusal rims or to the remaining teeth, the Arcus Digma will give you fast and accurate readings. A pin tracer is available through KaVo if pin tracing is your preferred choice of bite registration methods.

With computer calculations of steep or shallow condyle angles, your decision to use a steep or shallow cusped tooth to obtain bilateral balanced occlusion will be an easy decision. The Protar articulator is adjusted to the determined condyle angles and bennet angles. The incisal guidance and cuspal guidelines are set. With the articulator now moving precisely in the way the patients jaw moves the setting up of computer accurate balanced occlusion is quite easy. You can be sure that you are putting the exact curves into every set up for your patients unique requirements not just settling for average value curves or flat plane set ups.

With the confidence of this newly attained accuracy your setup will not be the weak link in expensive implant cases. You can verify every bite with repeatable accuracy. You can actually show your patient any jaw movement anomalies such as jaw clicking on the computer screen. You will be more confident with every denture insertion. You may even gain the confidence to construct dentures using very expensive porcelain teeth and have less fear of patients chipping or breaking teeth on these truly precision made dentures. No matter what cusp form tooth, this computer guides you to use on your patient you will know you have engineered a truly bilaterally balanced prosthesis that functions in harmony with every patients unique mandibular movements. With the accuracy of computerized jaw tracking in your practice you elevated the profession of denturism to a new height.

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**KaVo ARCUS® digma**

3D-ultrasonic navigator for diagnosis and therapy

- Fast, simple and accurate jaw registration – lower jaw sender (22g) together with the contact-free measuring principle enable a fast and easy fixation on the lower jaw
- Easy diagnostic capability
- Accurate programming of the articulator ensures good results and satisfies patients

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**Implants: Tips on Hygiene**

Your patients have opted for a high level technology: implantology. For implants to last, they must be cared for regularly just as natural teeth. This new brochure contains recommendations from the denturist as part of a good oral hygiene program.

The brochures come in packages of 100 and are available from the DAC at $20.00 per package. Thanks to l’Association des denturologistes du Québec for their partnership in developing this new practice tool.