A Protocol for Evaluating Condylar Position in Symptomatic TMD Patients

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Assessment of condylar position in symptomatic TMD patients is critical to their diagnosis and treatment. Farrar and McCarthy suggested that condylar retroposition is a predisposing factor to the development of internal derangement of the TMJ.[1] Pullinger and colleagues found that the condyles of 60 symptomatic patients were more posterior than those of 37 control patients.[2] Weinberg and Chastain have also emphasized the association between posteriorly located condyles and TMD.[3]

We have found it imperative to establish a diagnostic protocol for evaluation of condylar position and morphology in symptomatic TMD patients.[1-4] This article describes how the protocol works in our practice and presents a typical case history.

Examination Procedure

The patient history and clinical examination are the first and most important aspect of our protocol. The primary purpose is to identify any area or structure of the masticatory system that shows breakdown or pathologic change. Derangements in the masticatory system are generally signified by pain or dysfunction or both. A rule of thumb for identifying masticatory pain is that jaw movement will aggravate or accentuate the problem.[5]

To measure the discrepancy between centric occlusion (CO) and centric relation (CR), we mount the patient's models on the AD[2] articulator,* which uses the MCD (Measures Condyle Displacement) for three-dimensional assessment of the condylar position (Fig. 1).[4] The MCD has three independent recording tables: one lateral table on either side of the upper frame to measure sagittal and vertical distraction of the condyles, and one central table to measure transverse displacement. The recording tables have guide lines for the precise placement of custom graph paper, on which positional changes of the condyles between CR and CO are marked in all three dimensions: sagittal, vertical, and transverse (Fig. 2).

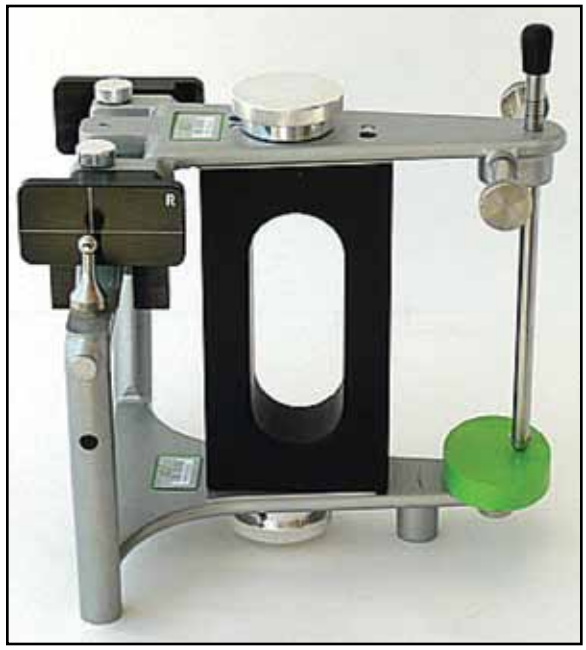

Fig. 1 AD[2] articulator with MCD (Measures Condyle Displacement). Right-side lateral recording table (black rectangle with cross-hairs) seen at upper left; transverse recording table not visible (reprinted with permission[4]).

*Advanced Dental Designs, Inc., Riverside, CA; www.ad2usa.com.

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Tomograms have traditionally been used to assess a patient's condylar position and morphology. A major limitation of this method, however, is that a normal-looking condylar position on the two-dimensional tomogram does not necessarily confirm a centrically related occlusion. With the introduction of cone-beam computed tomography (CBCT) in dentistry, 3D imaging of the condyles has become a reality. We use CBCT images with sub-millimeter slices (300 microns) to accurately view and evaluate the condylar position and morphology, without the higher radiation dosages of medical CT.[6-8]

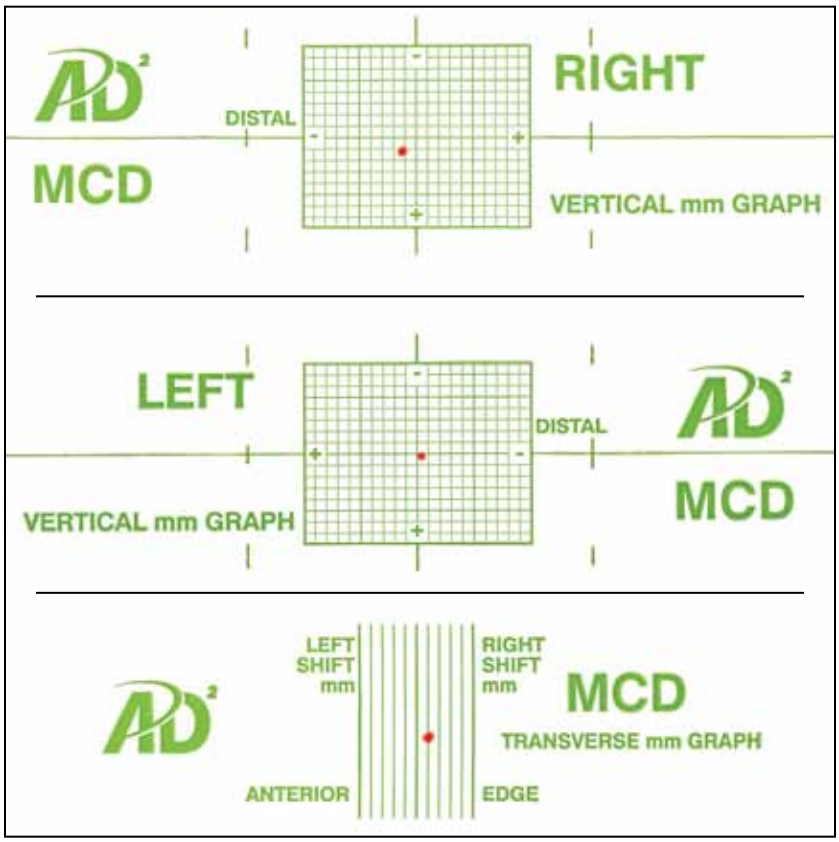

Fig. 2 Examples of MCD graphs; red dot indicates vertical, sagittal, or transverse condylar shift if positioned away from central cross-hairs (reprinted with permission[4]).

Fig. 3 A. 27-year-old female patient with upper and lower anterior crowding, open-bite tendency, lateral mandibular deviations on opening, and pain in right TMJ region. B. Dental casts show point of initial contact on palatal cusp of upper right second molar (top) and habitual occlusion in maximum intercuspation (bottom).

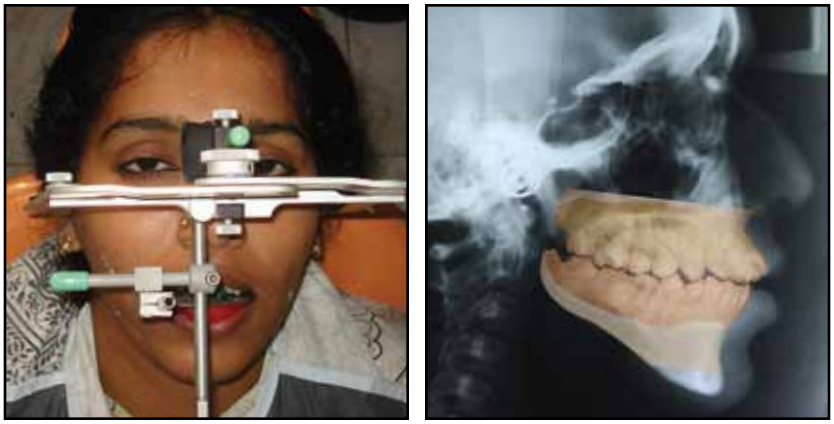

Fig. 4 Facebow registration taken and study casts morphed onto lateral cephalogram to confirm orientation of articulated study model to cranium.

Case History

A 27-year-old female presented with the chief complaints of irregular upper and lower front teeth and pain in the right TMJ region (Fig. 3A). She had a convex profile with incompetent lips, an acute nasolabial angle, and excessive lower facial height. On opening and closing, the mandible showed obvious deviations to the right and left sides. Examination of the TMJ revealed an initial click at 17-20mm, a maximum jaw opening of 38-40mm, and no tenderness on palpation. On manipulation of the mandible, the patient had initial contact on the palatal cusp of the upper right second molar, followed by maximum intercuspation (Fig. 3B).

Oral examination revealed a Class I molar relationship on the left side, a posterior crossbite on the right side, upper and lower anterior crowding, and reduced overbite and overjet, with no incisal or canine guidance.

A facebow registration was taken in preparation for mounting the patient's study casts on the AD² articulator, and images of the casts were morphed onto the lateral cephalogram to confirm the orientation of the models to the cranium (Fig. 4). MCD assessment showed the patient's left condyle distracted 2.5mm vertically and the right condyle distracted 2mm vertically and .5mm distally on maximum intercuspation, which is a significant deviation from the ideal centric relation. The transverse CR-CO discrepancy was .25mm (Fig. 5).

CBCT 300-micron sagittal slices of the TMJ showed that the right condyle was retropositioned,

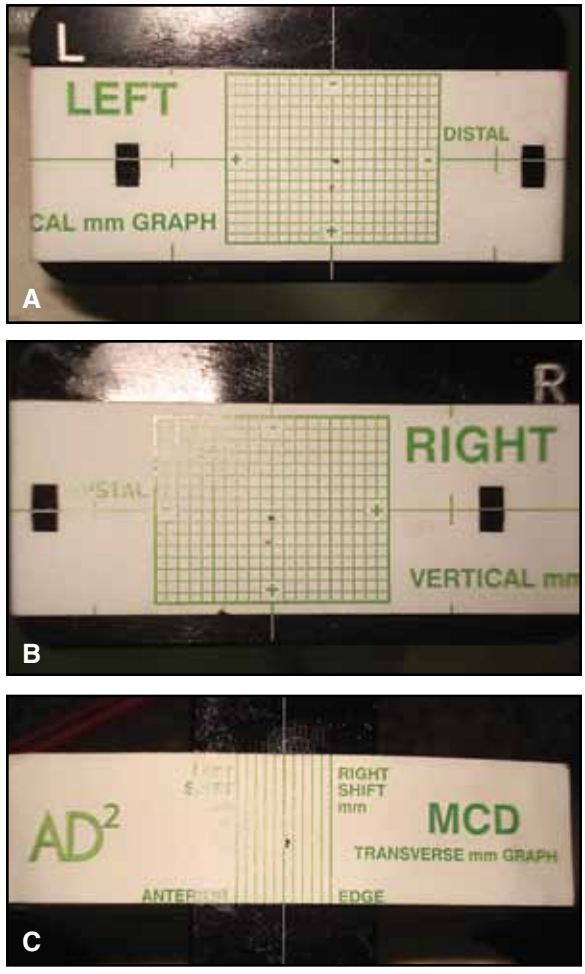

Fig. 5 A. Evaluation with MCD shows patient's left condyle distracted 2.5mm vertically (A) and right condyle distracted 2mm vertically and .5mm distally (B) in maximum intercuspation. C. Transverse CR-CO discrepancy recorded as .25mm.

with gross alteration of the condylar head morphology that could potentially lead to the development of TMD (Fig. 6A,B). A normal condyle in CR would be positioned more anteriorly and superiorly in relation to the temporal fossa (Fig. 7). Three-dimensional CBCT slices clearly showed an altered condylar position (Fig. 6C-E), verifying the MCD data.

Discussion

The condyle is in CR when it is positioned superiorly and anteriorly against the eminence, with the articular disc interposed between the two (Fig. 7). Ideally, this position should occur when the teeth are in maximum intercuspation, so that CR coincides with CO.[2,8-10] Neuromuscular pro-

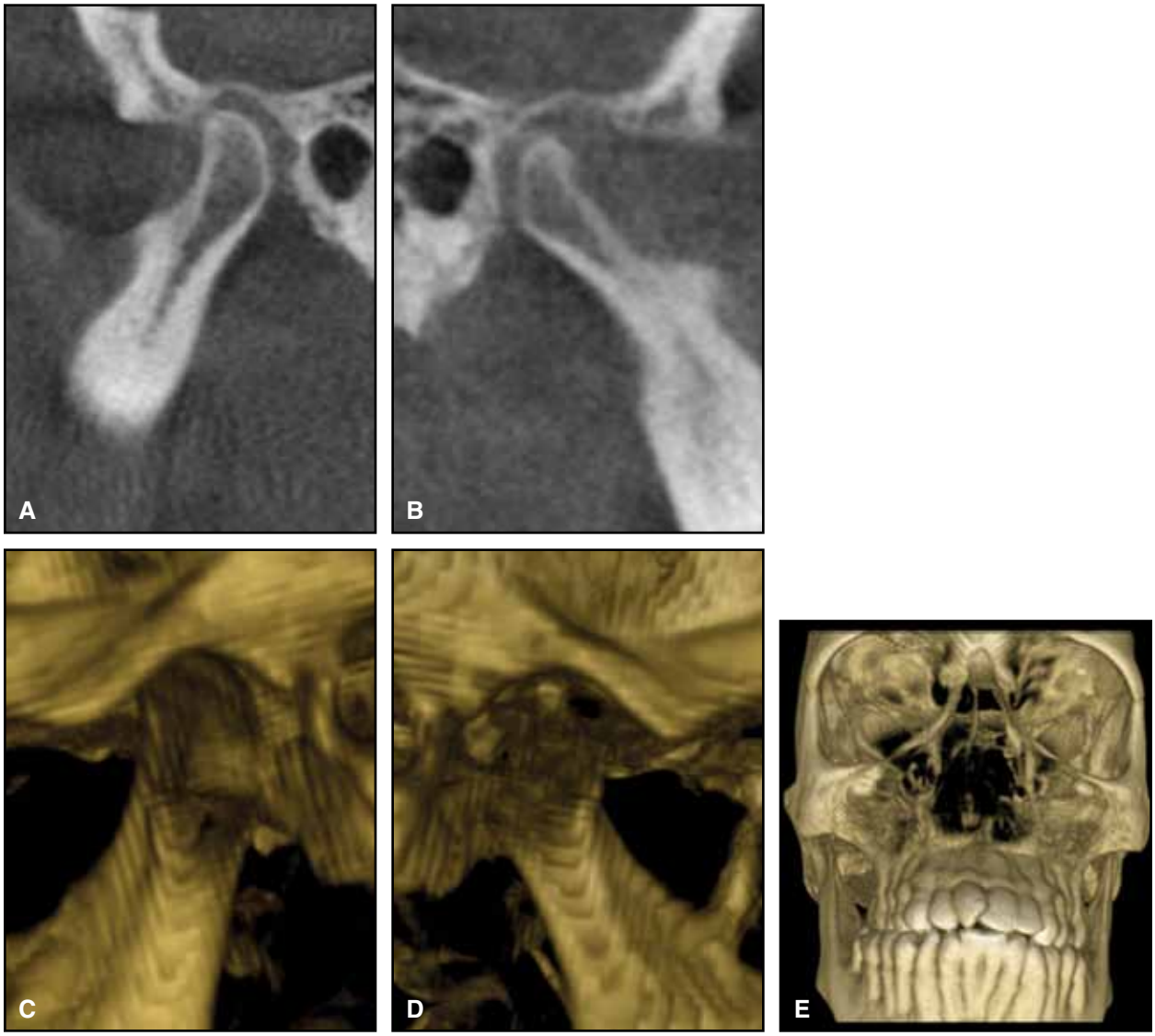

Fig. 6 300-micron CBCT images of patient's left (A) and right (B) condyles; 3D views of left (C) and right (D) condyles; anterior 3D view (E).

gramming causes a patient with a CR-CO discrepancy to avoid the CR cusp contact (fulcrum) when closing into CO. This change in mandibular positioning, known as "centric slide", represents the discrepancy between CR and CO. As noted by Roth, an articulator can detect such a CR-CO discrepancy because it is independent of neuromuscular programming.[10]

Because most patients with malocclusions have CR-CO discrepancies,[9] the functional goal of orthodontic treatment should be to match CR to CO. Roth and Williams felt that a vertical or sagittal distraction of as much as 1mm, measured with condylar position recording, was within the adaptive range of most patients.[9]

The most common cause of symptomatic TMD among patients who report to our clinic is a significant CR-CO discrepancy due to a retropositioned condyle. The patient shown here complained of pain in the masticatory apparatus, accompanied by headaches. The mounted models indicated a significant CR-CO discrepancy, and the MCD showed vertical condylar distractions ranging from 2mm to 2.5mm.

Radiographic confirmation of an altered condylar position is essential to a comprehensive diagnosis. Until recently, TMJ imaging relied largely on two-dimensional data from tomograms. With the development of lower-radiation CBCT, we believe it is now essential to evaluate the condylar morphology and position in three dimensions.[6] As long as TMD patients are screened using the initial steps of our protocol—patient history and examination followed by evaluation with the MCD—we strongly believe that the benefits of this relatively low CBCT radiation exposure outweigh the risks. The correlation of clinical findings, MCD values, and CBCT data establishes a comprehensive diagnostic protocol for the symptomatic TMD patient.

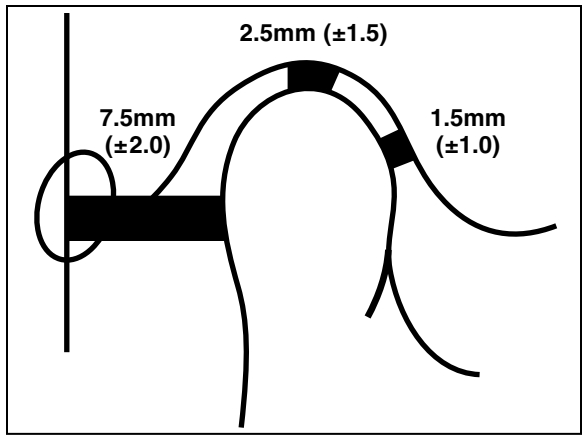

Fig. 7 Normal position of condyle in temporal fossa.

REFERENCES

1. Farrar, W.B. and McCarthy, W.L.: *A Clinical Outline of Temporomandibular Joint Diagnosis and Treatment*, Walker Printing, Montgomery, Alabama, 1983.
2. Pullinger, A.G.; Hollender, L.; Solberg, W.K.; and Petersson, A.: Radiographic condylar position, TMJ patients, and a screened control population, J. Dent. Res. 62:189, 1983.
3. Weinberg, L.A. and Chastain, J.K.: New TMJ clinical data and implication on diagnosis and treatment, J. Am. Dent. Assoc. 120:305-311, 1990.
4. Puente, J.A.; Alvarez, G.G.; and Obach, J.M.: *AD² Measures Condyle Displacement (MCD) Manual*, Advance Dental Design, Inc., Riverside, CA, 2008.
5. Okeson, J.P.: *Management of Temporomandibular Disorders and Occlusion*, 4th ed., Mosby, Chicago, 1998.
6. Alkhader, M.; Kuribayashi, A.; Ohbayashi, N.; Nakamura, S.; and Kurabayashi, T.: Usefulness of cone beam computed tomography in temporomandibular joints with soft tissue pathology, Dentomaxillofac. Radiol. 39:343-348, 2010.
7. Farman, A.G. and Scarfe, W.C.: The basics of maxillofacial cone beam computed tomography, Semin. Orthod. 15:2-13, 2009.
8. Petersson, A.: What you can and cannot see in TMJ imaging—An overview related to the RDC/TMD diagnostic system, J. Oral Rehab. 37:771-778, 2010.
9. Roth, R.H.: Functional occlusion for the orthodontist, Part 1, J. Clin. Orthod. 15:32-51, 1981.
10. Roth, R.H. and Rolfs, D.A.: Functional occlusion for the orthodontist, Part 2, J. Clin. Orthod. 15:100-123, 1981.