



**AD2 MEASURES
CONDYLE
DISPLACEMENT (MCD)
MANUAL**

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Condylar Position Recording

Something that surprises most orthodontists that start mounting their casts in Centric Relation (CR) is the frequency in which there are discrepancies between CR and Centric occlusion (CO).

This occurs in practically 100% of the articulated casts mounted in CR. Because of this, it is logical for the orthodontist to question why the occlusion observed in the patient's mouth is not the same as the one seen on the articulator.

Roth reinforced the concept of using an articulator said that "due to the lack of neuromusculature in the articulator, there are no cuspal interferences and the CR mounting will show us the real occlusion the patient has".

Because of the neuromuscular programming, when the patient closes they close into centric occlusion (fit the teeth together). They avoid the CR cusp contact (a fulcrum).

This change in mandibular position is known as "centric slide" and represents the discrepancy between CR and CO.

It is important to measure the discrepancy using the MCD.

Clinical studies have determined that the amount of discrepancy is minimal in most patients (80%) and generally these patients have adapted and do not have any pathology. However, the other 20% present discrepancies large enough to modify the diagnosis and treatment plan determined by the CO position. More work has shown that **these percentages increase significantly when the mandible is stabilized with splint therapy.**

So one may ask if this justifies recording CR and CO in all our patients.

The problem lies in the fact that there is no way to anticipate if the patient has a significant discrepancy or not. We suspect there is a problem when the patient is difficult to manipulate, or has a dolicofacial growth pattern, etc. but the only sure way of knowing is by measuring this discrepancy with properly mounted casts in CR. This is why we must mount the models in 100% of our patients and record the condylar position in CO with the MCD.

Method for recording condylar position

To measure the discrepancy between CO and CR, the AD2 articulator uses the MCD which is a diagnostic device designed exclusively to register and measure the position of the condyles in CO three dimensionally (Figure 1):

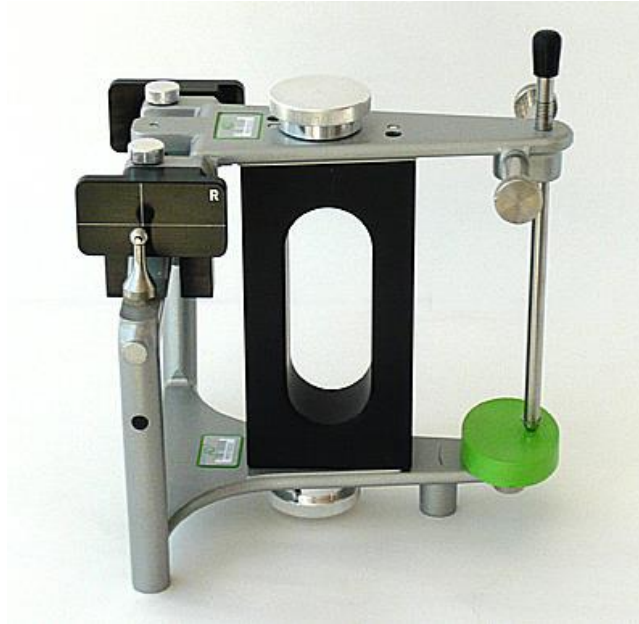


Figure 1. MCD

The MCD (Measures Condyle Displacement) has three independent recording tables: two lateral ones (one on each side of the upper frame) and one central table (located in the center of the lower frame) (Figures 2 and 3).

The lateral tables enable us to measure condylar distraction sagittally (anterior-posterior) and vertically, while the center table measures transverse displacement.

The recording tables have guide lines that are guides for the correct placement of the graphs where the distractions will be marked with articulating paper.

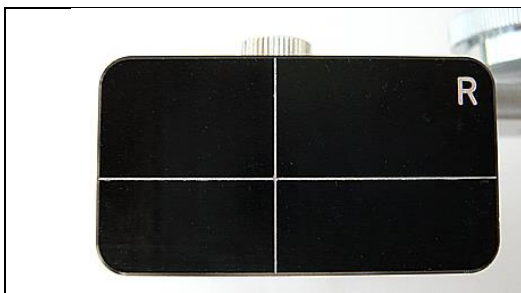


Figure 2. lateral recording table



Figure 3 transverse recording table

By means of millimetered graph papers that are placed on the three MCD recording tables, the position or distraction of the condyle in maximum intercuspal position (CO) can be accurately measured (Fig. 4). The graphs let us measure the discrepancies between CR and CO in all three dimensions: sagittal, vertical and transverse (the latter in tenths of a millimeter).

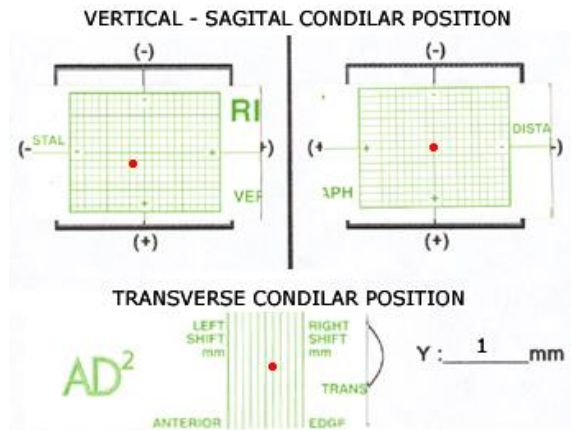


Figure 4. MCD graphs.

Figure 5 shows the MCD prepared for condylar position recording. Observe how the casts are in CO or MIP and the graphs have been placed correctly. All that is left to do is record the distraction with the articulating paper (usually red).

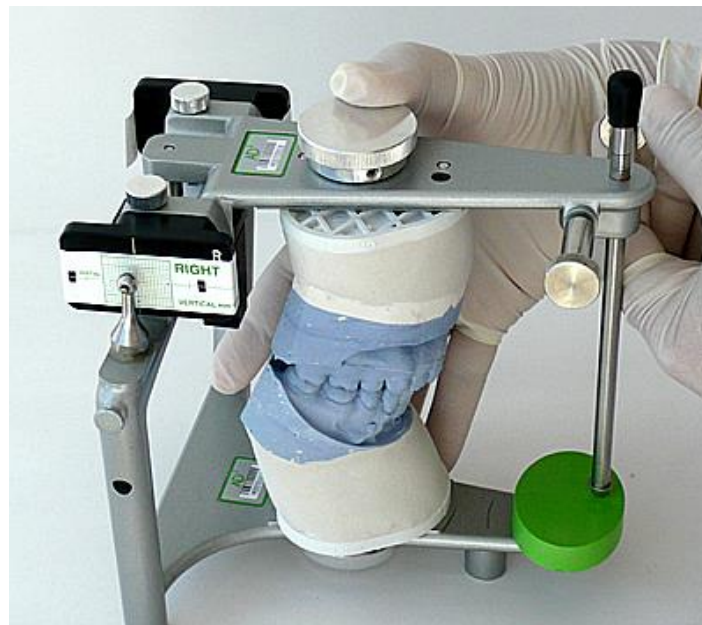


Figure 5. MCD with graphs in place.

The following materials are necessary to use the MCD (Fig.6):

1. Casts mounted on the articulator
2. CO bite recording
3. MCD instrument
4. MCD recording graphs
5. MCD data sheet
6. Red articulating paper
7. Scapel
8. 0.5 HB black pencil

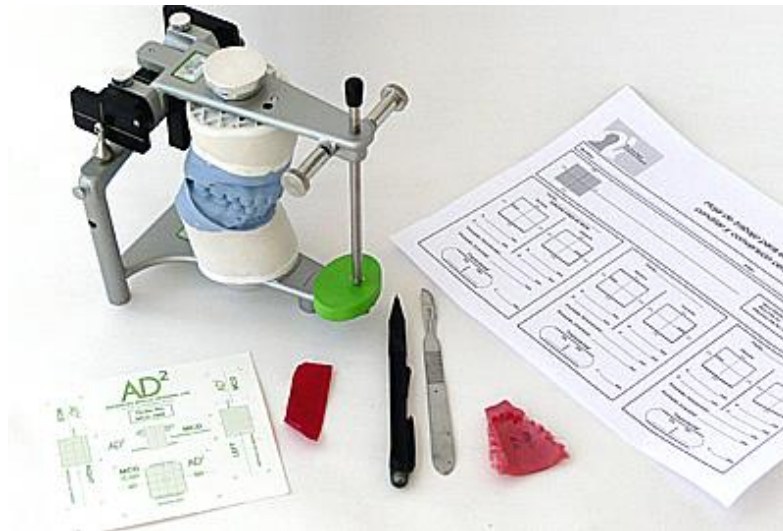


Figure 6. Materials used for the MCD recording

The information obtained from the articulator recordings is registered on a “MCD Datasheet” (Fig.7). It contains other information but for the MCD only use areas 1 and 2.



Condylar Position Recording and Cephalometric Conversion Data Sheet

Name: _____		Age : _____	
		<div style="border: 1px solid black; padding: 5px;"> CR Pin Height: _____ mm CO Pin Height: _____ mm CR-CO Difference: _____ mm </div> <div style="background-color: orange; color: white; text-align: center; width: 30px; height: 30px; margin-left: auto; margin-right: auto; font-weight: bold; font-size: 24px;">2</div>	
<div style="border: 1px solid black; padding: 5px;"> Date: _____ INITIAL CONDYLAR POSITION <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Right (+) X: _____ mm Z: _____ mm </div> <div style="text-align: center;"> Left (+) X: _____ mm Z: _____ mm </div> </div> <p>X Average (horizontal): _____ mm Z Average (vertical): _____ mm</p> <div style="text-align: center;"> Transversal Y: _____ mm </div> </div> <div style="background-color: orange; color: white; text-align: center; width: 30px; height: 30px; margin-left: auto; margin-right: auto; font-weight: bold; font-size: 24px;">1</div>	<div style="border: 1px solid black; padding: 5px;"> Date: _____ <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Right (+) X: _____ mm Z: _____ mm </div> <div style="text-align: center;"> Left (+) X: _____ mm Z: _____ mm </div> </div> <p>X Average (horizontal): _____ mm Z Average (vertical): _____ mm</p> <div style="text-align: center;"> Transversal Y: _____ mm </div> </div>	<div style="border: 1px solid black; padding: 5px;"> Date: _____ <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> Right (+) X: _____ mm Z: _____ mm </div> <div style="text-align: center;"> Left (+) X: _____ mm Z: _____ mm </div> </div> <p>X Average (horizontal): _____ mm Z Average (vertical): _____ mm</p> <div style="text-align: center;"> Transversal Y: _____ mm </div> </div>	

Figure 7. Condylar Position Recording Datasheet

Area 1: the MCD graphs seen in Fig.4 are placed in this area after the condylar distraction has been recorded. The data sheet provides for three different MCD recordings.

Area 2: two lines where the incisal pin height in CR and CO are recorded.

Wax preparation

Before explaining the steps necessary for using the MCD, it is necessary to refer to a very important aspect that is generally underestimated, and that is the way the CO wax bite is prepared before it is used in the MCD recordings.

Removing excess wax from the occlusal and palatal sides is a procedure more complicated than it seems. The main function of the wax is to help obtain a better fit between the upper and lower teeth, without altering the vertical dimension. Therefore, the wax will be correctly prepared when the vertical dimension in CO does not vary when the wax is or is not placed between the casts.

Observe fig.8, where the upper and lower casts are mounted on the MCD, the CO wax is in place.



Figure 8. The wax is correctly adapted when the pin height in CO does not vary, with or without the wax between the teeth.

To measure the vertical dimension in CO, the first step is to firmly hold with one hand the MCD with the casts in CO, and with the other hand, let the incisal pin contact the incisal table. Now read the height marked on the pin. In this example, the value was – 1.0 mm; write it down on the data sheet next to “CO Pin Height”.

If holding the articulator with one hand is too difficult then hold it with both and have someone else loosen the incisal pin.

Next, lift the pin and remove the wax. Measure the vertical dimension in CO, but without the wax. This way the measurements can be compared and if they are different then it is because the wax is interfering with the occlusion. In these cases, take the scapel and remove all excess wax (occlusal, palate, etc.), until the vertical dimension in CO is the same with and without the wax.

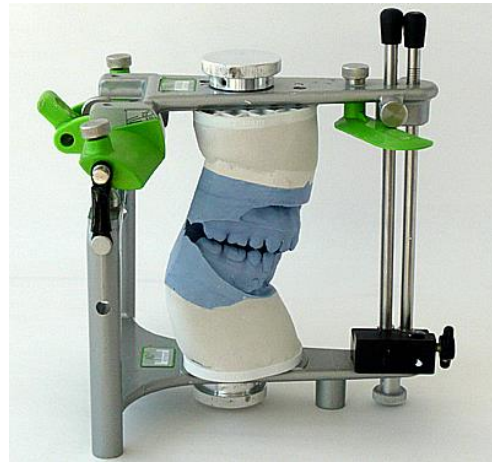
This condition is important for a reliable MCD recording.

All this may give the impression that to save chair and lab time it would be better not to take a CO wax bite and to proceed with MCD recordings of the casts occluding at the best possible fit. This is not recommended since there will be cases when, without the help of the wax, it will be difficult to find a stable occlusion (for example in open bites). This instability is even harder when the casts have to be held to record the condylar position.

Steps for recording the MCD

Step 1

With the casts mounted in CR, let the incisal pin contact the incisal table. Check the pin height and remember that above zero (green line) the value is (+) and below it the value is (-).



Step 2

Write down the pin height on the MCD data sheet next to “CR Pin Height”.

In this example the value was +2 mm, which represents the vertical dimension of the casts in CR.

CR Pin Height:	_____	mm
CO Pin Height:	+ 2	mm
CR-CO Difference:	_____	mm

Step 3

Remove the casts from the articulator, place the CO pink wax bite between them, and hold them in your hands. We are trying to determine the best fit between the teeth and at the same time, avoid breaking any teeth.



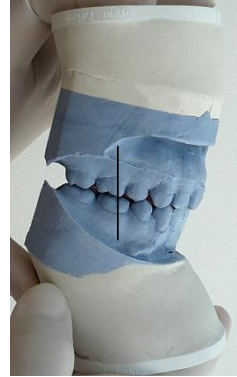
Step 4

Cut out all excess from the wax.



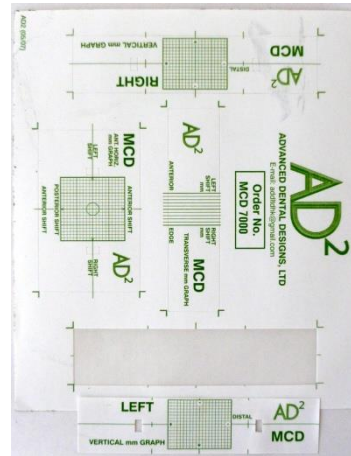
Step 5

Place the wax again between the casts and hold them with one hand. With the other, draw a vertical line with a pencil, passing through the mesial cusp of the upper first molar, on both sides. This line will represent the molar relation in CO.



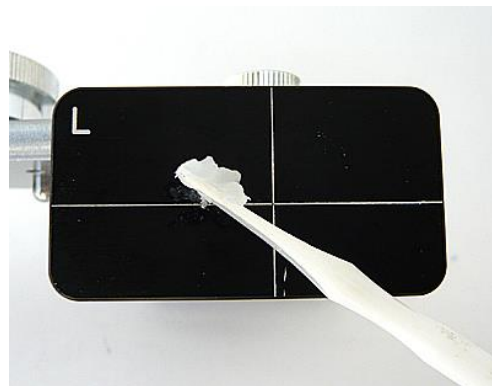
Step 6

Have the millimeter graphs available. The two holes on the sagittal graphs for the condylar side tables will help align the graphs on the lateral recording table.



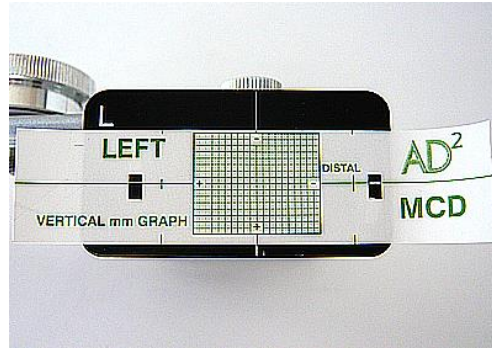
Step 7

Apply some vaseline, or aquaphore or silicone on the recording tables. Wipe off the excess vaseline or aquaphore thoroughly before placing the graphs. The separating medium will prevent the graphs from adhering too strongly to the tables. The horizontal and vertical lines are used to align and center the graphs.



Step 8

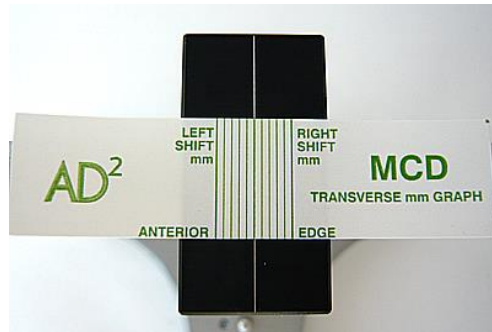
Place and center the graphs superimposed on the vertical and horizontal lines on the recording surface with those on the graphs. Once it is centered, fold and press the ends of the graphs on the side of the tables.



Step 9

Place the graph paper on the transverse recording table, make sure that the word “anterior” on the graph and the initials MCD on the graph will be facing the front of the MCD.

The dark central line of the graph must superimpose on the center line of the MCD recording table.



Step 10

Place the upper and lower casts on the MCD. Invert the upper member of the MCD and put the CO bite on the upper teeth. Carefully place the lower cast with the teeth fitting into the dental indentations. Turn the MCD upright and place on the table. Place gentle pressure directly over the casts to seat the teeth completely into the CO bite. Drop the incisal pin to the incisal guide table. The MCD is stable to touch between the pin and the mounting plate screw. Never touch posterior to the mounting screw - the casts will be displaced from the CO bite. Record the incisal pin reading. .



Step 11

Confirm the vertical dimension in CO, repeating the previous step, but now without the wax in between. If the height is the same, go to the next step. If not, re-check and cut off any excess wax.

Record the condylar displacement with the CO wax bite in place.



Step 12

If the vertical dimension of the models in CO is the same with or without the wax, write down the value next to “CO Pin Height”.

Generally, this value is less than the “CR Pin Height”, recorded in steps 1 and 2.

In this example, this value was –1 mm. and the difference between CO and CR will be 3 mm.

CR Pin Height:	- 1	mm
CO Pin Height:	+2	mm
CR-CO Difference:	3	mm

Step 13

Hold the casts in CO firmly with both hands and ask someone to place articulator paper between the lateral recording table and the condyle on the lower frame.

Hold the paper in one hand, and with the other hand, hold the table by the sides and move it 2 or 3 times to record the vertical and sagittal distraction of the condyles on the graph paper.



Step 14

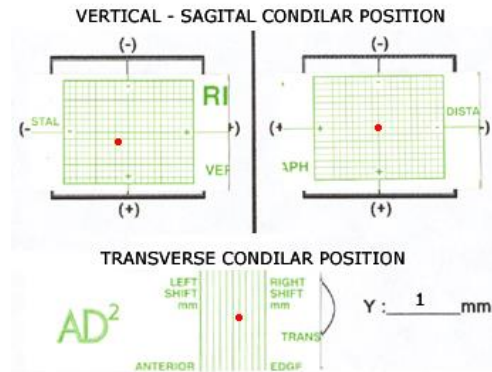
Keep the casts in CO, ask your assistant to place the articulating paper between the center pin and the table that measures transverse displacement.

Your assistant must lift the recording table upwards and mark the graph paper. This will record the direction (right or left) and the amount of displacement of the condyles.



Step 15

Remove the three graph papers and cut them as shown here, and place them on the MCD data sheet. Write down the date these were taken and the values obtained.



Frequent errors when using the MCD

1. Incorrect wax preparation.

The main function of the wax is to serve as a guide to find the best fit in CO between the upper and lower teeth, without increasing the vertical dimension. For this reason, all wax in contact with occlusal grooves, embrassures and soft tissue must be removed.

An exaggerated trim is not recommended since it will lose its adaptation with the teeth and will not be useful as a guiding tool.

Compare the untrimmed wax in figure 9 with the same wax but trimmed in figures 10 and 11.



Figure 9. CO wax before any excess was removed.



Figure 10 & 11. CO wax in position, after having been properly trimmed.

2. Incorrect alignment of the graphs.

Incorrectly aligning the graph (Fig. 12) alters the condyle position being recorded. The mark may even be above CR on the graph.

This mistake is often seen in those who are just learning how to use the MCD. In time and with more experience, this mistake can be easily controlled.

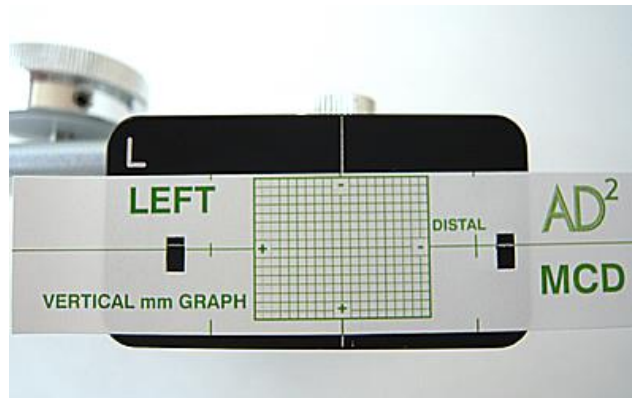


Figure 12 Incorrect alignment of the graph paper.

MCD interpretation – General aspects

The MCD recording graphs (Fig.4) have been designed to measure in three dimensions the condylar distraction or displacement in CO with respect to CR.

To adequately interpret the MCD value, it is fundamental to consider other aspects related to mandibular and articular dynamics, as well as some basic dental occlusion concepts (type A,B,C, contacts, etc.).

It is not the objective to analyze this in detail, but to highlight certain aspects related to the interpretation of:

1. The information contained in the design of the recording graphs
2. Direction and degree of condylar displacement

Vertical and sagittal distraction will be considered first and then transverse displacement.

MCD –vertical and sagittal distraction

To understand the information recorded on the graph, one must analyze the graph in detail. For example, figure 13 is a zoom of the right condyle recording graph. The center of the graph is CR and the red dot made by the articulating paper represents the position of the condyle in CO.

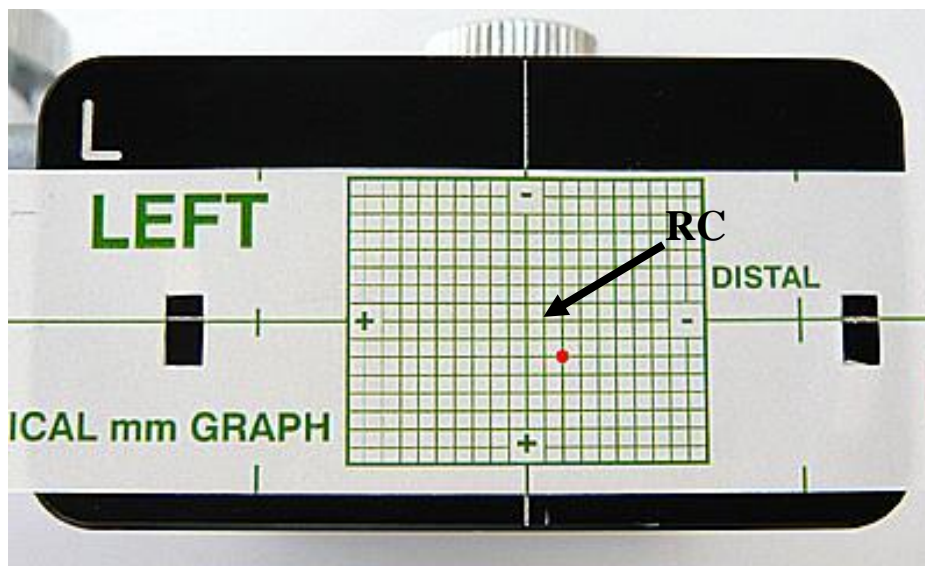


Figure 13: MCD graph of the left condyle.

Each square of the graph represents 1 mm. and the four signs: two (+) and two (-), indicate the distraction direction of the condyle with respects to CR.

The (+) sign always means there is a mesial and/or inferior movement of the condyle and the (-) sign indicates a distal and/or upper movement. The quadrant where the red dot is indicates the direction of condylar distraction.

It is important to note that from an anatomic point of view, a superior distraction of the condyle with respects to CR (red dot above CR) is not possible. Do not forget that CR is the upper most position in the glenoid fossa so the condyle cannot go any further. Sometimes the CO recording may mark above the CR reference point. This recording may be the result of a lab technique error or a mistake in recording CO and CR. The exception to this is when the first contact in CR is on an anterior tooth such as a Class III case. The CO will mark above the CR because in CR the posterior teeth are apart but in CO the teeth are in contact.

The downward distraction is the most frequently observed (Wood, Crawford, Roth, Dawson). In more than 90% of the cases, the MCD shows a vertical distraction of the condyles in relation to CR. A large percent of the distractions are down and back. About (8%) are straight down.

The vertical distraction component is much greater than the horizontal one. There is an anatomical reason since CR is the upper most, anterior and medial position of the condyle in the fossa which makes it very difficult, if not impossible (due to the glenoid fossa's shape), to move mesially or distally, without having to descend first. This explains why vertical distraction is greater than the sagittal one.

Another aspect observed when comparing MCD records in both TMJ's, is the relationship that exists between dental occlusion and condylar distraction. This becomes apparent when the occlusion of the CR mounted casts is evaluated and the first contact is marked. The largest condylar distraction is on the side of the first contact. The fact that a premature dental contact prevents proper condylar seating, once more confirms the enormous importance occlusion has as an etiological factor in TMJ signs and symptoms.

MCD – transverse distraction

The transverse table shown below (Fig. 14), with its graph paper measures the transverse displacement of the condyles in CO.

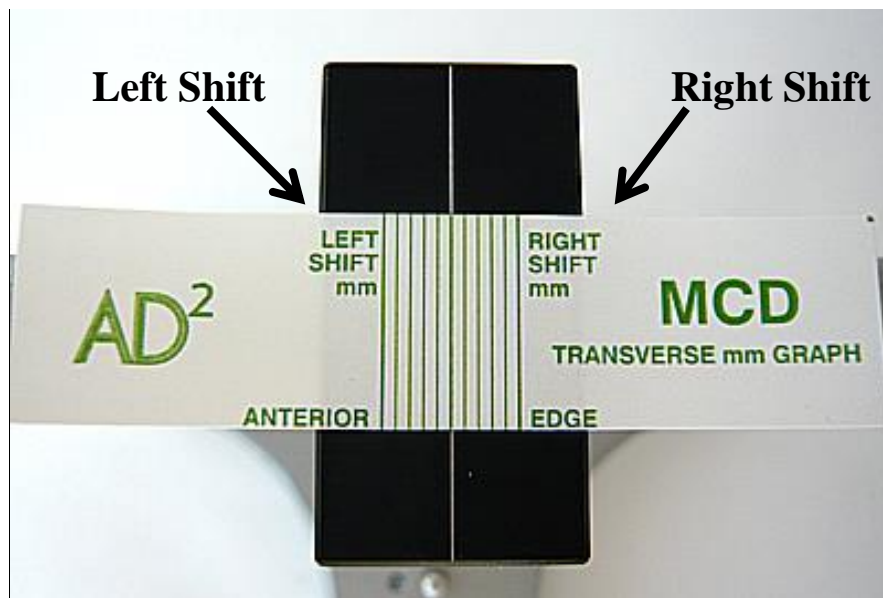


Figure 14. MCD and graph paper for transverse displacement recording.

Make sure the graph paper is placed correctly (see step 9). Note on the right side of the graph is printed “LEFT SHIFT mm.” and on the left side the words “RIGHT SHIFT mm.” are printed.

Why is it that on the right side of the graph it records the left displacement?

On the AD2 articulator, the upper member moves, while the lower one is static. The upper member is the one that can move laterally. The articulator movements are made by the upper member (maxilla) and not by the lower member (mandible). Imagine a patient that due to a dental interference or premature contact, presents a mandible that accommodates to the left in order to reach maximum intercuspation. This desire for MIC can generate a transverse displacement of the condyles that could produce clinical symptoms. When measuring this patient’s transverse displacement on the MCD the red mark will be on the right side of the graph paper to show the jaw (mandible) movement. The mark is on the right side where it is printed on the graph “LEFT SHIFT”, which is what is really happening in the patient’s mouth. The patient’s mandible moves, but the top of the articulator moves.

Final considerations

The coincidence between CO and CR is an ideal treatment objective. This is very difficult to achieve by orthodontic and/or surgical means. For Roth and Williams, a vertical or sagittal distraction of up to 1 mm., measured with the condylar position recording, are acceptable. This is probably in the adaptive range of most patients. Transverse measurements should not be greater than 0.3 mm. These observations indicate that the greater the displacement, the greater the incidence of joint problems.