

**Mandibular Movement  
Recordings and Articulator  
Adjustments Simplified**

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Judging from the volume of writing that has appeared in the dental literature and the number of courses presented in recent years on jaw movements and articulators, it would seem that most of the questions related to this subject would have been resolved. The variety and sophistication of the research techniques employed to measure mandibular movements and positions indicate the interest and desire for new knowledge.

**THE PROBLEM**

The articulating device used to relate working casts for the fabrication of restorations in many commercial dental laboratories is not selected by the dentist. Instead, the technician uses an articulator of his own choosing, usually a hinge-type plastic or metal cast relator. Exceptions can be found in some geographic areas where energetic study clubs have produced highly trained and motivated advocates of mandibular movement recordings and adjustable articulators.

During the past decade many attempts have been made to teach pantographic techniques but the acceptance has not been widespread. Techniques of oral rehabilitation that play down or minimize the use of articulators may have attracted a greater number of followers.

In this article I will attempt to show that most condylar border movement patterns are not as complex as the armamentarium to record it would indicate. Computer analysis of a larger number of recordings<sup>2</sup> has revealed that most patients' patterns of condylar move-

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ment resemble each other. A simplified condylar movement analyzer\* has been developed to identify quickly a patients' characteristic movement patterns. Articulator controls that satisfy most patients' condylar movement patterns are then selected from a set of five preformed motion analogs.\*

### CONDYLAR BORDER MOVEMENT STUDIES

The Lee pantograph system<sup>1</sup> was used to record the condylar border movements of several hundred subjects (Fig. 1). A computer analysis method developed by McCoy<sup>3</sup> was used to analyze the movement patterns of 163 selected subjects.

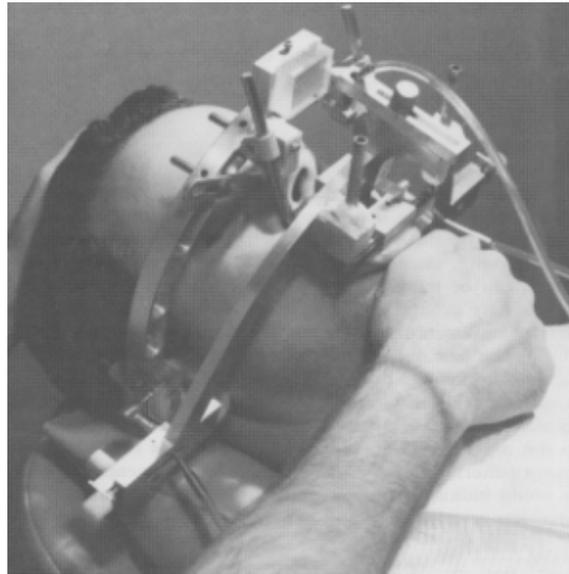


Figure 1. The Lee mandibular movement recorder utilizes air turbine drills to engrave the condylar movement pathways in solid plastic blocks. (Courtesy of Dr. Robert L. Lee).

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\* Panadent Corporation. Colton, California

The results contributed little to what had already been known from previous studies concerning the lateral and protrusive condylar pathways as viewed in the sagittal plane. But new insight into the character of the Bennett movement component became apparent, because the tip of the recording drill traced a three-dimensional pathway in the clear plastic blocks that could be easily stored and measured.

All recordings were made with the plastic blocks oriented to the patients' axis orbital reference plane. The pathways derived from the computer data are expressed in angles relative to this plane. The average curvature of the condylar pathways for all subjects had a radius of approximately three fourths of an inch.

Frequency distribution histograms<sup>2</sup> developed from measurement data of the recording blocks were used to evaluate some practical working parameters of condylar movement pathways. It was found that the average protrusive condylar pathway angle was approximately 45° with 80 per cent of all the pathways located between 30° and 60°. Similarly the average lateral balancing side pathway was 55°, with 80 per cent located between 40° and 70°. The Bennett movement described here represents the amount of inward movement of the balancing side condyle as it moved downward and forward 3 to 5 mm from its terminal hinge position (Fig. 2). The average Bennett movement was 0.75 mm with 80 per cent of all subjects distributed between 0.0 and 1.5 mm.

### **SIMPLIFIED MANDIBULAR MOVEMENT BORDER**

A simplified mandibular movement recorder has been developed to analyze quickly the characteristics of a patient's condylar movement relative to known parameters (Fig. 3). This recorder is not used to set an articulator directly.

The recording procedure consists of cementing a facebow to the patient's lower teeth using a disposable plastic clutch tray. The side arms of the facebow hold horizontal styli oriented to the patient's arbitrary or true hinge axis. Vertical parallel recording plates on the upper facebow are located close to the face. The upper facebow is supported by the nasion anteriorly and rests over the ears posteriorly, held on firmly by a rubber band around the back of the head.

Lead pencil marking tips of the styli draw the protrusive and lateral movement pathways on the vertical plates (Fig. 4). The amount of inward movement made by the condyle on the balancing side during its first 3 to 5 mm of forward and downward translation is used to measure the patient's Bennett movement. The mandible is firmly guided along the right and left lateral border pathways. The movement can be repeated several times to verify each pathway.

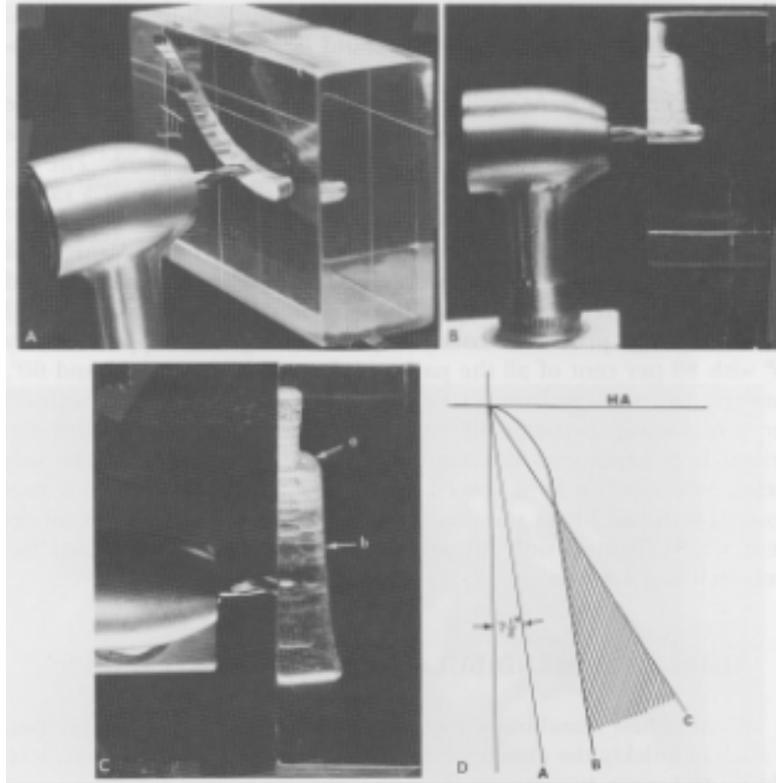


Figure 2. A. The character of the condyle pathway during a left lateral movement is shown in this close-up view of the clear plastic recording block. B. A frontal view shows the air turbine drill at the limit of left lateral movement. C. This superior view clearly shows the nature of the inward movement of the balancing side condyle (a) that occurs during the first few millimeters of downward and forward travel. After the initial inward movement (Bennett movement) has occurred, the remainder of the pathway (b) resembles an arc of a circle about the rotating working side condyle. (Fi. 2, A to C reproduced from *J. Prosthet. Dent*, 30:869, 1973, with permission). D. The average Bennett angle (A) obtained from the data of this study was approximately  $7\frac{1}{2}^{\circ}$ . Variations between patients' Bennett movement recordings occurred during the first few millimeters of lateral movement. Once the Bennett movement had occurred the remainder of the pathway B differed from pathway A only in its initial displacement. Line C represents the type of Bennett angle guide setting often seen in semiadjustable articulators which results from the use of lateral positional records. The shaded area between lines B and C was not found in these studies.

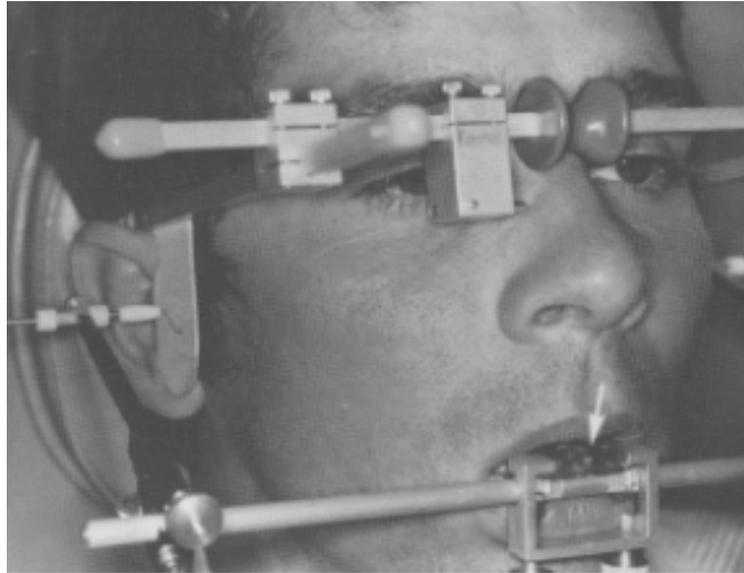


Figure 3. The mandibular movement analyzer is attached to the lower teeth using a plastic disposable clutch tray and quick setting plaster. The arrow points to a curved insert that contacts the maxillary incisors and serves as a central bearing device. The upper bow carries the vertical recording plates and the anterior reference point marker.

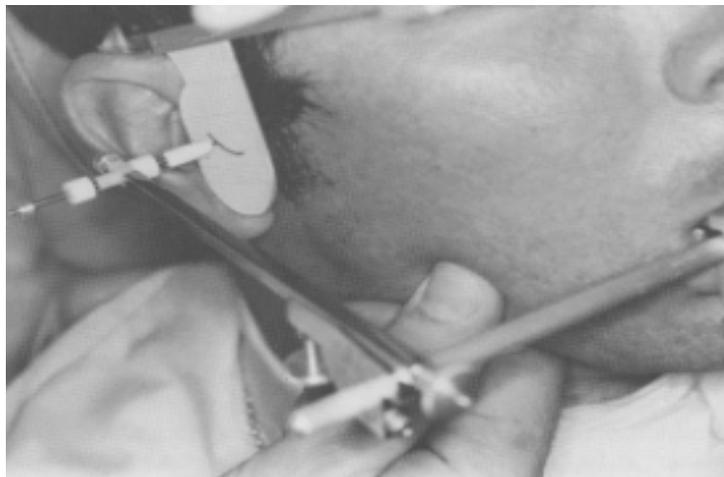


Figure 4 The mandible is firmly guided to produce the border movements.

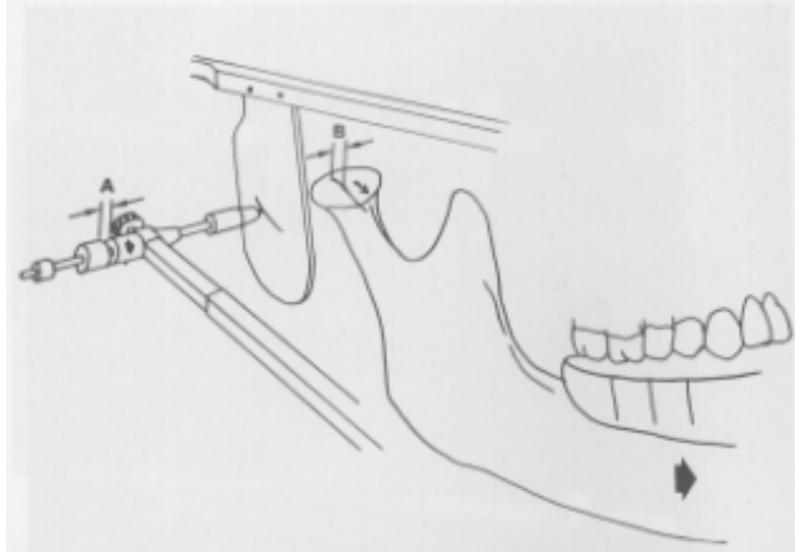


Figure 5. The amount of inward movement that occurs initially at the condyle (B) can be measured in millimeters on the horizontal stylus (A). The side arm of the face bow slides along the horizontal stylus, which is held against the vertical plate creating the space (A) with a Teflon spacer that was closed before the movement started.

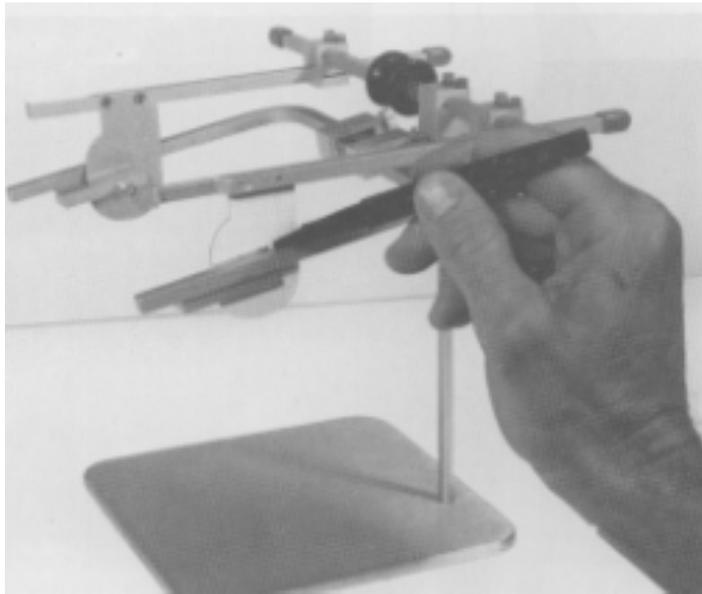


Figure 6 A supporting stand is used to hold the upper facebow while relating the recorded condylar pathway to the axis orbital plane.

Bennett movement is measured in millimeters on the horizontal stylus which remains against the vertical plate as the side arm stylus holder telescopes inwardly. The separation distance between the Teflon stopper and the stylus holder is measured with a Boley gauge (Fig. 5).

The clutch tray does not have a central bearing screw and opposing table which is used in other panograph recorders to hold the teeth apart and provide a smooth gliding surface contact. Instead, a curved plastic insert located on the lower clutch tray opposing the maxillary incisors functions as the bearing device. If the patient is edentulous in the maxillary arch, the residual anterior ridge contacts the curved insert of the mandibular clutch tray.

The condylar movement pathways tracings on the vertical plates are next related to the patient's axis-orbital plane. This is done by drawing a line on the recording plates using a reference plane guide that connects the hinge axis points posteriorly with the anterior reference point (Fig. 6). A hinge axis type facebow transfer will now orient the occlusal lane of the maxillary cast to the patient's recorded condylar pathways. The ear facebows can also be used with this system which approximates these relationships.

### SIMPLIFIED ARTICULATOR CONTROLS

Articulator adjustments are accomplished very quickly by using performed condylar motion analogs (Fig. 7) developed from data on the measurement of approximately 200 patient recordings. Each of the preformed articulator controls has a common condylar pathway curvature with a radius of  $\frac{3}{4}$  inch. Five pairs of controls were developed with varying Bennett movement allowances in half millimeter increments from 0.5 to 2.5 mm (Fig. 8).

The preformed controls are precision made in a special hard surface resin. Rotation about the hinge axis of the articulator permits adjustment of the condylar pathway angles (Fig. 9A). Setting the articulator pathway angles can be done by measuring the recorded angles with a protractor or by tracing the recorded pathway on acetate tracing paper (Fig. 9B) and using it directly to adjust the articulator (Fig. 9, C and D).

Measurements of Bennett movement obtained in millimeters from the recorder are used to select the appropriate corresponding preformed articulator control.

The articulator is designed with a positive centric holding latch that permits only hinge movement when engaged and is released for lateral movement (Fig. 10A). In addition, centric locking keys are engaged to hold condylar spheres in their hinge position during the mandibular cast mounting procedure (Fig. 10B).

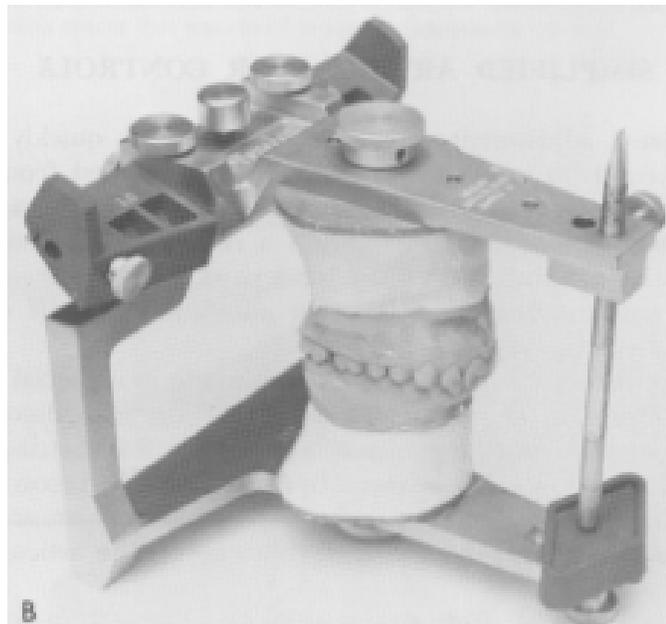
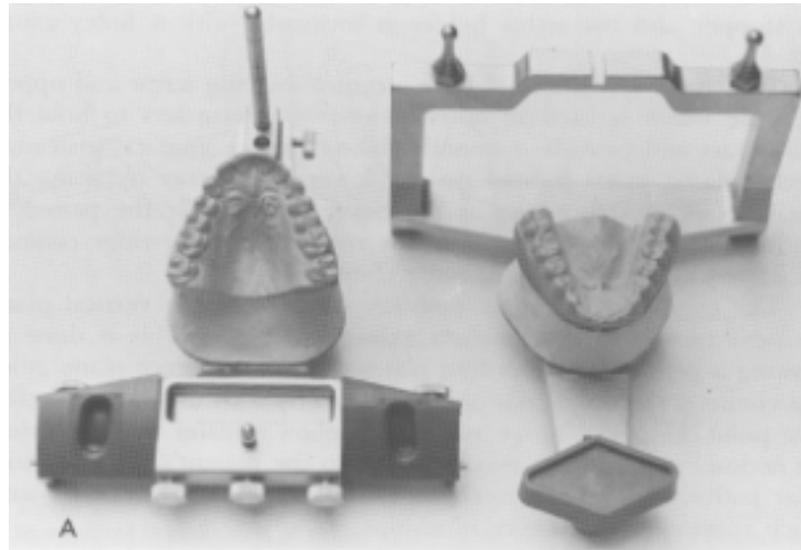


Figure 7. A. The Arcon articulator has interchangeable condylar pathway controls. A slot in the cross bar of the lower member is the guide for the centric latch. B. The laboratory technician sets the articulator by attaching the controls with the predetermined Bennett movement numbers and turns them to the selected condylar pathway angles.

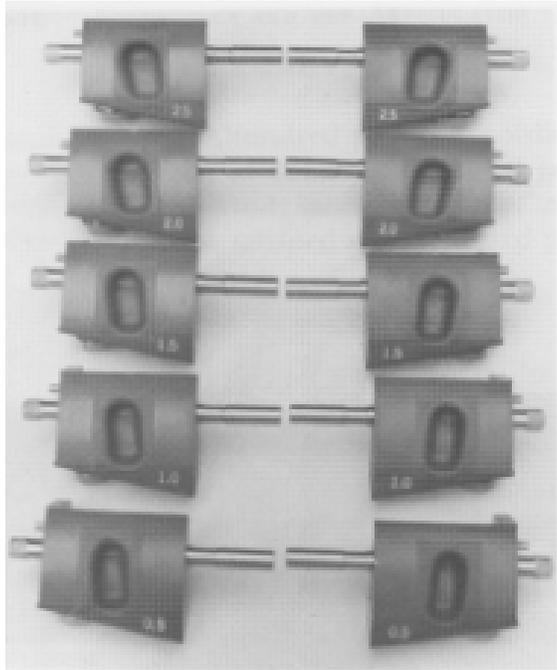


Figure 8. Five pairs of condylar controls provide half millimeter increments of variations in Bennett movement. The curvature of the eminentia is common to all. The working side condylar sphere moves in a straight lateral direction only.

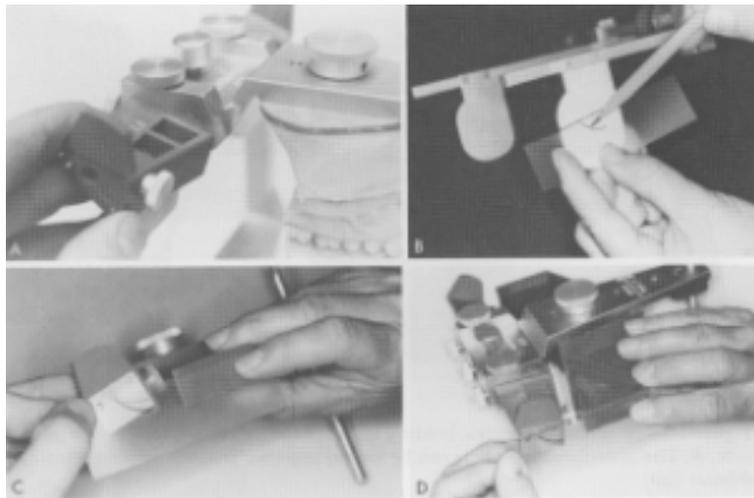


Figure 9. A. the calibrations for the condylar angle give the technician a quick reference number to set the articulator. B. A method of transferring the patient's condylar movement pathway angle to the articulator using an acetate strip. C. A standard metal template is placed over the articulator control representing the preformed condylar pathway curvature. A specially designed extension block is attached to the uppr member to provide a method of extending the axis orbital plane laterally to the condylar control. The acetate strip can now be used to transfer the angel drawn from the recording plate D. The articulator adjustment is completed when the condylar pathway angels coincide by rotating the articulator control.

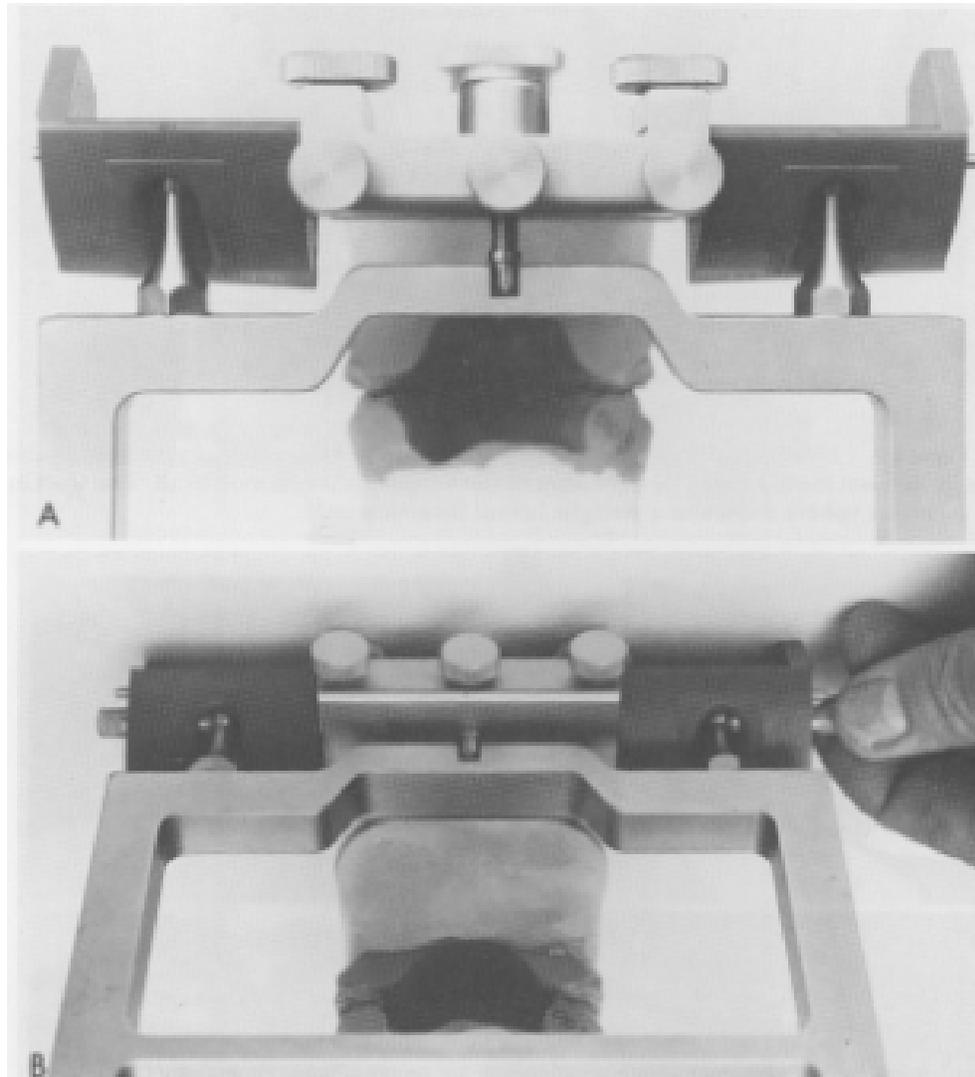


Figure 10. A. When the centric holding latch is engaged, only a hinge movement can be made. B. The articulator members can be locked together securely while mounting the mandibular cast.

### SUMMARY

Research data from several hundred patient recordings using the Lee method have been utilized to design a simplified jaw movement analyzer and articulator. The study also shows that most patient's movement characteristics can be satisfied with standard preformed articulator controls.

### REFERENCES

- <sup>1</sup> Lee, R.L: Jaw movements engraved in solid plastic for articulator controls. I. Recording apparatus. J. Prosthet. Dent. 22:209, 1969.
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- <sup>3</sup> McCoy, R.B., Shryock, E.F., and Lundeen, H.D.: A method of transferring mandibular movement data to computer storage. J. Prosthet. Dent. 33:510-516, 1976

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