

# Using Intraoral Gothic Arch Tracing to Balance Full Dentures and Determine Centric Relation and Occlusal Vertical Dimension

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The ability to establish an accurate, verifiable, and reproducible occlusal vertical dimension (OVD) and centric relation (CR) is a clinical skill. With this skill comes the ability to create an occlusion that is harmonious, functional, and comfortable to the edentulous patient in need of prosthetic treatment. Additionally, the establishment of such an occlusion is invaluable in the fabrication of complete dentures or in cases involving dentures opposing a natural dentition. Whether the patient is completely or partially edentulous, the benefits of a comfortable, accurate, and consistent OVD and CR are enormous.

As will be discussed in this article, the task of capturing OVD and CR has long been the work of the Gothic arch tracer. It has been a staple of restorative dentistry for nearly a century, but the difficulty of assembly coupled with most clinicians' perception of the Gothic arch tracer as an excessive and unnecessary procedure has relegated its use largely to academic circles and those in the milieu of prosthodontics. However, the development of a balanced and harmonious occlusion should be of paramount concern to any dental practitioner. An intraoral Gothic arch tracer provides an accurate and reliable means of capturing OVD and CR, but in a way that is far more accessible to all practitioners without the technique sensitivity and unique challenges of traditional Gothic arch tracers.

Before any discussion of the future of Gothic arch tracers, however, it is important first to examine its history. We, as a profession, cannot know where we are going without first knowing how far we have come.

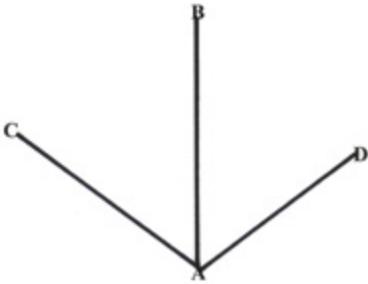
## HISTORY OF THE GOTHIC ARCH TRACER

Since the days of Pierre Fauchard, dental practitioners have sought to restore their patients' dentitions and overall oral health as a means to create optimum aesthetics, function, and phonetics. Even as far back as the ancient Egyptians<sup>1</sup> there is evidence of primitive dental practices and "crown and bridge" restorations. Ironically, it was attrition and not dental decay that most often plagued the teeth of the peoples of ancient Egypt. This attrition was certainly exacerbated by the composition of their diet, but it was also influenced by their malocclusions. If they had had the understanding of a destructive occlusion and the means to treat it, their dental health likely would have been far better than what is seen archaeologically.

As our profession became more sophisticated, and more and more instances of TMJ pathology and occlusal disharmony were observed, an effort was born to resolve these destructive practices. Pioneers such as Harper, Schiffman, Ellinger, and Gysi sought a means to eliminate occlusal discrepancies by utilizing Gothic arch tracers to determine the optimal CR and OVD of their patients, and then, through selective occlusal grinding and rehabilitation, achieve that goal.<sup>2</sup>

The need to address problems in articulation that resulted in disharmonious occlusions is mentioned as far back as 1910. It was Gysi's contention that if accurate alignment of the maxillary and mandibular anterior dentitions could be achieved, the result would be a vast improvement in phonetics, function, and aesthetics in the construction of dental prostheses.<sup>3</sup> It has long been the contention of this theory's supporters that correcting occlusal disharmony would also resolve a large portion of reported TMJ pathology and its associated musculoskeletal symptomatology. The Gothic arch tracer makes such equilibrations possible, and the result has, in fact, been a significant decline in such pathoses.

However, as mentioned earlier, despite the proven advantage it allows the clinician in recording the relationship of the anterior teeth in CR to permit them to balance equally, the Gothic arch tracer remains a largely underutilized tool. The reasons for this are twofold. First, early Gothic arch tracers were considered technique sensitive. The entire occlusal consonance could be compromised with even a slight variation from true CR and OVD. Secondly, and ironically, it is the difficulty in assembling the extraoral Gothic arch tracer that makes such human error so prevalent. On the other hand, intraoral Gothic arch tracers provide all the advantages of their early counterparts, but do so with far greater simplicity.



**Figure 1.** Arch tracings of protrusive and lateral movements.

The principles of both the new and old Gothic arch tracers are the same. First, a stylus is mounted in either the lower finished denture or in the lower recording base during denture fabrication. A flat plate is then attached to the maxillary denture or upper recording base. The flat plate is then coated with some type of marking material—crayon, articulating paper, or a permanent felt-tip marker. The dentures or bases are then returned to the mouth, and the patient is instructed to assume a retruded mandibular position. Next, the patient is instructed to advance the mandible into a protrusive position. These paths of extreme retrusion and protrusion are repeated several times to ensure they are accurately captured on the upper tracing plate. The patient is then instructed to carry his or her mandible into its most lateral movements, and these movements are similarly captured on the upper tracing plate. Once these various tracings have been made, the protrusive path (Figure 1: AB) and the lateral movements (Figure 1: AC, AD) can be observed and

measured. These measured and observed tracings can then be applied to denture and prostheses fabrication and equilibration.

However, with older Gothic arch tracers the process was cumbersome and fraught with angst. In our age of technology, even several systems of computer-aided Gothic arch tracers allow the clinician to produce minutely accurate measurements and tracings.<sup>4</sup> However, the cost of such equipment and the difficulty in assembling the hardware make such systems impractical. An accurate, inexpensive, and easy-to-use alternative for determining OVD and CR in the edentulous patient for whom we are constructing complete upper dentures with lower dentures, lower partials, or lower natural dentition is the new intraoral Gothic arch tracer, the Establisher.

The basic setup consists of 3 parts: a striking plate, the contact plate, and a threaded pin. When properly mounted on finished full upper and lower dentures, the intraoral tracer acts as a central bearing device for achieving balanced denture occlusion. With the simple addition of the centric pin receiver, the tracer can be utilized to record OVD and CR.

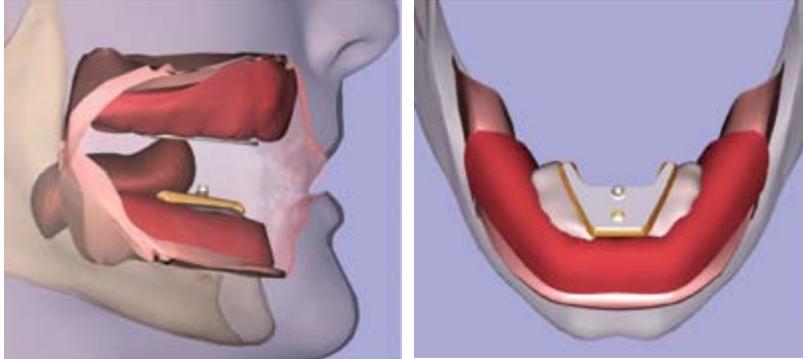
#### **MOUNTING THE ESTABLISHER TO BALANCE FULL DENTURES OR WITH BASEPLATES WHEN DETERMINING OVD AND CR**

##### **Balancing Full Dentures**

Light-cure material and bonding agent will be needed for this procedure.

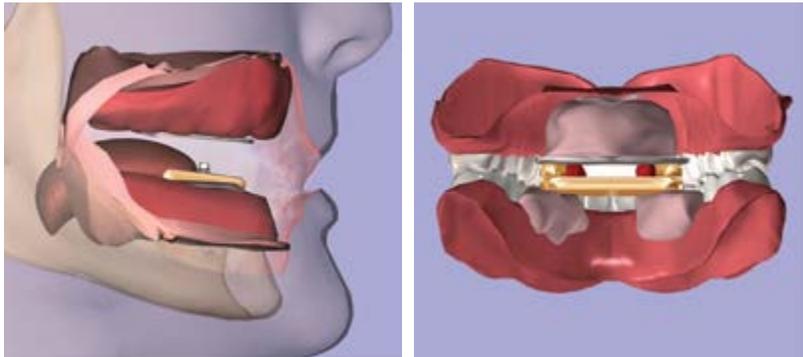


**Figures 2a and 2b.** Superior and lateral views of the mounted contact plate.



**Figures 3a to 3d.** Views of the mounted contact plate.

**3b.**



**3c.**

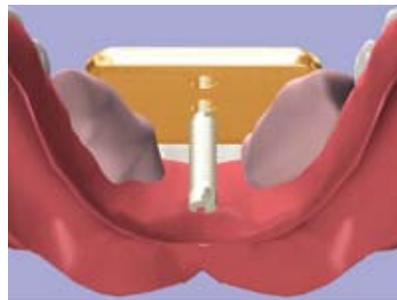
**3d.**

(1) Attach a 3-hole contact plate to the central lingual surface of the lower denture or baseplate. A 2-hole contact plate can be used to allow for more space for patients with large tongues. Light-cure material is recommended for ease of use. Alternatively, sticky wax, stick compound, or other stabilizing adhesives may be used. When securing the contact plate, it is important to align one of the tapped holes with the approximate center point of the denture or baseplate (Figures 2a and 2b). It is important that the plate be level and slightly below the occlusal plane (Figures 3a to 3d).

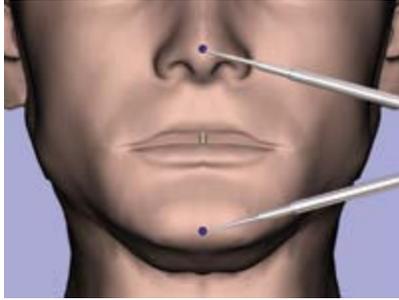
Attach a striking plate to the upper denture or baseplate (Figure 4). A smaller-sized striking plate can be used in the event that the patient's palate is too narrow to accommodate the standard-size striking plate. It is important that the striking plate is level and slightly above the occlusal plane. To make both the maxillary and mandibular parts parallel and provide space for the threaded pin to work with ease, place the second contact plate on top of the mounted contact plate. Align the maxillary and mandibular dentures or baseplates on top of each other to ensure the proper positioning.



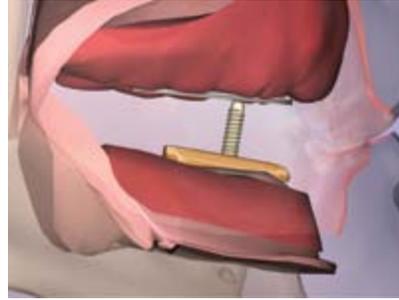
**Figure 4.** Mounted striking plate on upper denture.



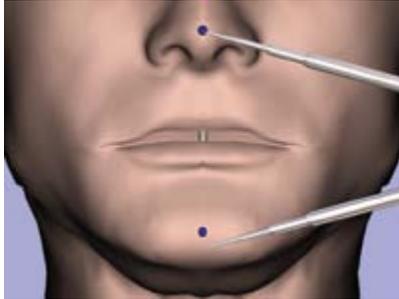
**Figure 5.** Threaded pin insertion.



**Figure 6.** Caliper measurement of nose tip and chin landmarks for CR.



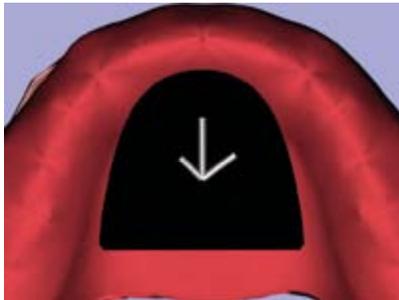
**Figure 7.** Slight contact of lower threaded pin with upper striking plate.



**Figure 8.** Determination of freeway space using calipers.



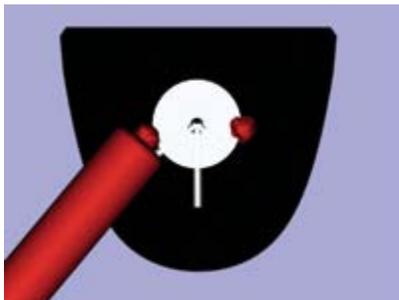
**Figure 9.** Application of indelible marker to upper striking plate.



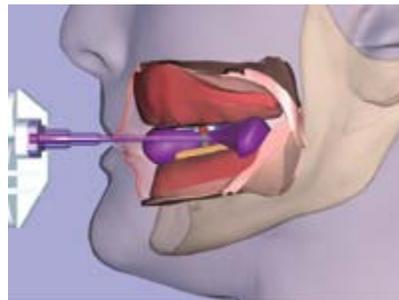
**Figure 10.** Typical Gothic arch tracing.



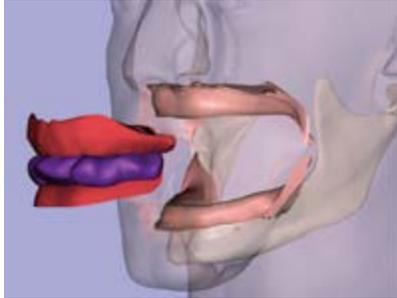
**Figure 11.** Alignment of the tracing's arrow point with the center of the centric pin receiver.



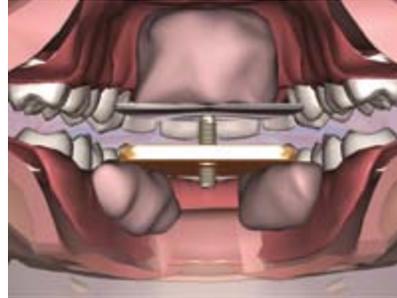
**Figure 12.** Luting of the centric pin receiver with wax.



**Figure 13.** Syringing of impression material between upper and lower baseplates for obtaining bite records.



**Figure 14.** Removal of bite records.



**Figure 15.** Dentures slightly out of occlusion in all excursions.



**Figure 16.** Even distribution of markings on posterior teeth as seen in correct C R.

(2) Insert a threaded pin into the centered tapped hole. A long threaded pin is provided to facilitate variations in OVD amongst patients. If the threaded pin is too long for the floor of the mouth, the clinician may cut the bottom of the pin opposite the dome (Figure 5).

Note: Check the stability of both the contact plate on the lower and the striking plate on the upper by applying light pressure both inward and outward with your fingers. If either plate comes loose, simply place a drop of medical grade cyanoacrylate cement between the 2 surfaces to resecure the bond. Before reusing and sterilizing, be certain to remove any excess or residual cement or light-cured material.

### **Instructions for Taking OVD and CR on Baseplates**

You will need the following for this procedure:

- nonpermanent marking pencil
- adjustable caliper
- indelible ink and felt applicator
- dental wax (or light-cure material with adhesive properties)
- ADA-approved bite plaster or bite registration material.

(1) Mount the apparatus as previously described. Many clinicians may choose to enlist their lab to mount the apparatus at the time the lab fabricates the baseplates. This will save invaluable time for the clinician as the baseplates will arrive from the lab ready to use.

(2) Record the patient's physiological rest position (PRP):

- Using a nonpermanent marking aid, place a dot on the tip of the patient's nose and another dot on his or her chin.

- Have the patient take a deep breath, relax, and release his or her breath several times while concentrating on completely relaxing the jaw muscles.

- When the clinician is confident the patient is fully relaxed, adjust the caliper so the points of the caliper touch the dots on the nose and chin (Figure 6). Lock this position on the caliper for future reference. This measurement represents the patient's physiological rest position.

(3) Rotate the threaded pin clockwise into the contact plate of the lower baseplate. Continue rotating to bring the dome of the threaded pin to a position that may contact the striking plate nearest to the patient's rest position.

(4) Find the patient's proper freeway space to obtain a working OVD:

- Place the upper and lower baseplates into the patient's mouth and instruct the patient to close slowly until the dome of the threaded pin touches the striking plate (Figure 7).

- Locate the locked caliper that represents the patient's PRP and place a leg on the dot of the patient's nose. Compare the position of the opposite leg with the position of the dot on the patient's chin. The goal is to decrease the distance between the 2 dots by 1 to 4 mm, the rest position (Figure 8). This measurement can vary slightly depending on the patient's muscular condition. The difference between the PRP and OVD is the freeway space. The freeway space is the necessary space between the occlusal surfaces of the upper and lower dentures when the patient is at rest. Make adjustments as needed to achieve the appropriate OVD.

- Rotate the threaded pin counterclockwise to increase or clockwise to decrease the height as needed. Repeat until you have achieved the proper OVD with some freeway space.

(5) Using indelible ink (or its equivalent), apply a solid layer of ink on the striking plate (Figure 9).

(6) Find the patient's repeatable point of centric relation. Insert bases into the patient's mouth at the appropriate OVD position.

Instruct the patient to perform the following movements:

- Lightly tap the threaded pin onto the striking plate.

- Close until the threaded pin touches the striking plate.

- Keeping the threaded pin touching the striking plate during all of the following lower jaw movements:

\*Rub forward and back several times.....then HOLD!

\*Then wiggle side to side.

(7) Remove the upper baseplate from the patient's mouth and inspect the Gothic arch tracing made by the patient's movements. The tracing should reveal a defined arrow shape (Figure 10). If the arrow is unclear, then repeat. The tip of this arrow delineates the most repeatable centric position. Note: If there are any variations in the shapes of the arrow, the tracing may indicate malalignment of the disc assembly. Make certain to repeat the tracing until a repeatable marking is seen. The tip of the arrow is generally the best guide for finding CR. An asymmetrical arrow is normal.

(8) Place the centric pin receiver on the flat striking plate with the beveled edge countersink hole facing up (Figure 11). Align the center point of the arrow with the hole in the centric pin receiver and lock into position using adhesive wax (Figure 12).

(9) Place the upper baseplate into the patient's mouth and guide the patient in placing the dome of the threaded pin into the hole of the centric pin receiver. Once seated into the receiver, have the patient hold this position.

(10) When satisfied that the threaded pin is properly seated into the centric pin receiver, inject bite registration material between the upper and lower baseplates (Figure 13). The patient must maintain the position as the material sets. Allow the bite registration material to set. Carefully remove the finished record from the patient's mouth (Figure 14).

## Balancing Full Dentures Using the Establisher

Needed for this procedure:

- articulating paper
- equilibration bur.

- (1) Mount the apparatus to the upper and lower dentures as previously described in the mounting instructions.
- (2) Rotate the threaded pin clockwise into the contact plate of the lower denture.
- (3) Continue rotating to bring the dome of the threaded pin to a starting height position in contact with the striking plate. The patient's dentures should be just out of occlusion in all excursions (Figure 15).
- (4) Rotate the threaded pin clockwise one fourth of a turn.
- (5) Use articulating paper in the patient's mouth above the occlusal surface and instruct the patient to tap-tap and rub their dentures. If no marks transfer, rotate pin until first point of contact.
- (6) Remove the dentures and analyze the marks transferred to the teeth. Premature contact will be apparent by marks on 1 or more teeth, but usually not evenly on all posterior teeth.
- (7) If prematurities exist, spot-grind the marked cusps or fossae with an equilibration bur.
- (8) Proper occlusion will be apparent by the existence of marks evenly on all posterior teeth (Figure 16). Note that this gives only CR spots. In order to attain balanced eccentric

occlusion, the clinician should instruct the patient to rub his or her jaw side to side while articulating paper is held between the teeth. Adjust-ments can then be performed until the clinician is satisfied with the occlusal adjustment. Finally, remove the apparatus and polish the occlusion.

## CONCLUSION

At first glance, the use of the intraoral Gothic arch tracer may seem technique sensitive and difficult. But with a small learning curve and adherence to the principles described herein, consistent, repeatable, and accurate OVD and CR can be established intraorally on any patient. Once these relationships have been determined, it is a simple task to equilibrate the occlusion as needed to achieve occlusal harmony in any type of prosthesis construction. The century-old practice of Gothic arch tracings as aids to fabrication of complete dentures and other types of prostheses is invaluable, but the technique sensitivity of the procedure coupled with the difficulty of applying the records makes conventional Gothic arch tracings inefficient. However, the minimal investment of time needed to master the intraoral Gothic arch tracer makes it an inexpensive, simple, and reliable alternative.

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