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Review Article

An Understanding of Gothic Arch Tracing- A Clinical and Academic Rapid Review

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Abstract

An accurate Maxillo-Mandibular relation is required for the creation of Optimum Function, Esthetics And Phonetics, in Complete Denture Prosthesis, to establish the desired occlusion aswell. For this, a proper clinical skill is required to establish an accurate, verifiable and reproducible vertical dimension of occlusion (VDO) and centric relation (CR). Muscle tone, inter-dental arch space and parallelism of the ridges are some of the factors to record the vertical relation correctly. Error in maxillo-mandibular relation recording can lead to uncomfortable and un-wearable dentures.

Gothic arch tracing is a crucial procedure involved in the fabrication of accurate and precise complete denture prosthesis. This procedure, if done correctly, will help eliminate the errors in the final prosthesis and ensuring an accurate complete denture. Gothic arch tracer (with a central bearing device) is a tracing mechanism to determine the centric relation. Although, this may take more time than the traditional jaw relation, and does involve a learning curve too. With accurate patient training and cooperation and apt knowledge on the topic, we can eliminate mistakes ensuring the final goal.

Keywords: Gothic Arch Tracing; Clinical; TMJ

Introduction

In the horizontal plane, the mandible can be related to the maxilla in several positions. Among these centric relation holds a significant position of high value and importance, because of its usefulness in relating to the maxilla, where the teeth, muscles and the TMJ function in harmony. The definite positioning of the prosthesis into centric relation will determine the accurate position of the mandible and hence will project the future success of treatment.

To understand the Gothic Arch tracing one must understand the importance, correlation and significance of Centric relation (GPT 9) [1], which will not only help in tracing the arch but also establish a strong base for the complete denture prosthesis's success. Basically, it is the position from which, the excursive movements of occlusion start and in which the teeth meet in habitual closing movements. The tentative jaw relationship using the denture base and occlusion rims is most widely used in clinical practices. However, many dentures with an unstable occlusion are seen, which can be attributed to the errors which occur during the clinical procedures. A proper reproduction of centric relation and establishing the vertical dimension is the key to the success of any prosthesis.

As the mandibular movements and condylar position gets affected by the patient's proprioceptive nervous system, the occlu-

sal rim method is still not the favorable option. The arrow point tracing is a better method which records the mandibular border movements in the horizontal plane and also provides a reproducible mandibular posterior border position.

Methods of recording centric relation

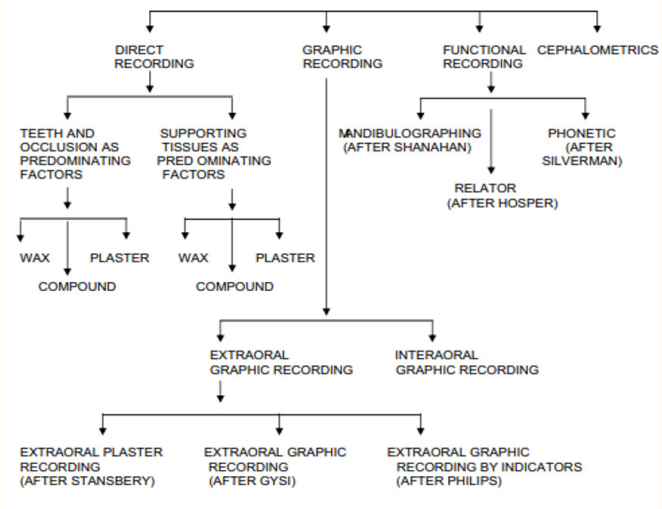

Chart 1: Methods of recording centric relation [2].

Recording centric relation in edentulous subjects

Centric jaw relation in edentulous patients are commonly recorded using: Wax closure method, Functional chew in technique, Graphic method and Anterior deprogrammers.

The differences in the concepts of occlusion and posterior tooth form in fabricating complete dentures creates the differences in the merits of eccentric records.

The factors that contribute to the inaccuracy of centric record in edentulous patient are as follows:

- Instability of records
- Displaceability and resiliency of denture bearing tissues
- Materials used in record making
- Equipment used in record making
- Inability of muscle coordination by the patient
- The commonly used articulators which do not adjust to all the lateral interocclusal check records accurately.

Interocclusal records

The inter-occlusal records and their accurate recording also play a key role during the clinical procedure of gothic arch tracing. However, accuracy is at times questionable, be it in terms of the record produced or its representation on the articulator, which finally dictates the fabrication of the prosthesis.

Many conclusions have been made, regarding the perfect material for the inter-occlusal record. *Trapozzano* stated that wax checkbite method was more accurate. According to *Schuyler*, if the recording medium's density and viscosity were not consistent, uneven pressures would be transferred to the record bases, which would lead to an unbalanced occlusion. For occlusal records, he stated that modeling compound is superior to wax because it may be softened more evenly, cools more slowly, and exhibits less distortion.

For the record, *Payne* and *Hickey* preferred plaster since less material needed to be put in the patient's mouth. Dental materials such as plaster or zinc oxide-eugenol paste, which was considered more accurate.

Hanau was among the first people to think about pressure equalization when recording the bite. He proposed the acronym "Realeff," which stands for "resilient and like effect." The resilience of the oral tissues evolved to be a crucial element in "checkbite" approaches.

Wright had mentioned the resiliency of tissue, saliva film, fit of denture bases, and pressure exerted as elements that he believed affected the accuracy of records. He concluded that the ideal strategy was to record the occlusal record at zero pressure because the dentist couldn't control the pressure at which the record was created. Thus, it might be reproduced.

Gysi performed this technique on manikins and found that neither wax nor compound produced the same recording twice. He concluded that distortion was caused by the material's uneven cooling. He only discovered accurate plaster for interocclusal recordings [3].

Both the varieties of materials and the methods used for "Getting The Jaw Back" were diverse. Clinicians must instruct their patients, to naturally reposition their mandibles into a 'retruded position'. In an effort to create the retruded posture of the mandible, this was combined with having the patient swallow, touch their tongue to their soft palate, perform quick jaw motions to exhaust muscles, and other approaches. Numerous scholars argued in favour of having some control over jaw movement. Typically, the mandible was being guided or the chin was being lightly pressured. Numerous decisions for "Checkbites" for centric relation records have been made. The majority of these complaints came from those who supported graphic recording in some way [3].

Gothic arch tracing

The Horizontal Jaw relation is recorded using the gothic arch tracer. The patient will need to return to the clinic in this case, however, the ultimate choice may be made using the gothic arch trace. The masticatory muscles surrounding the TMJ would be free to return to their correct physiological position if we could remove the wax bite rim and confine masticatory forces to a central bearing point in the mouth, creating a fulcrum of support for the mandible. By doing this, a patient-generated vertical could be easily and precisely recorded. Without a doubt, the intersection of protrusive and excursive motions would accurately reflect the centric relation if there were a mechanism to record the path through these movements. The Gothic Arch Tracer precisely accomplishes this.

Certain border movements are observed to obtain such a tracing. An inward and forward lateral movement of one condyle is followed by a movement in the opposite direction with rotation taking place around the opposing condyle, these movement cut lines go all the way to the point where both condyles are most retruded. The needlepoint of the trace will therefore be resting at the apex of the trace when both condyles are in their most retruded position. A needlepoint tracing is essentially a single representation of the mandibular region and its movements in a horizontal plane [4].

Classification of graphic recordings

- Extra-oral tracing unit
- Intra-oral tracing unit

Extraoral tracers

- Hight tracing device

Figure 1: Hight Extraoral tracing unit.

- Stans berry tracers
- Sears tracer

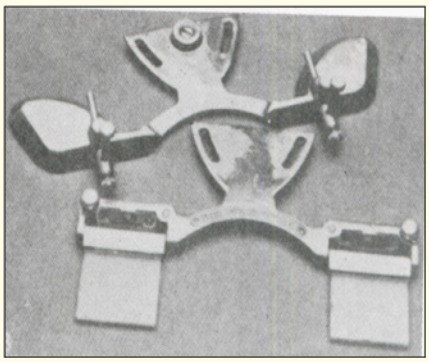

Figure 2: Sears extra oral tracer assembly.

- Chandra tracer
- Philips extra-oral tracer

Hight tracer

The hight tracer is a four-component assembly, which consists of an upper and a lower assembly.

Both a lower bearing plate with a central screw/bearing point and a central bearing point on the central bearing plate (connected to the maxillary arch).

At the midpoint of the mandibular arch is where the central bearing point is set. The scriber point is joined to the upper rim, and a forward-extending tracing platform is joined to the lower rim (Figure 3-5).

Figure 3: Tracer assembly seen, as mounted on a semi adjustable articulator.

(In picture- Artex Semi adjustable (non arcon) Articulator, with Height tracer units attached).

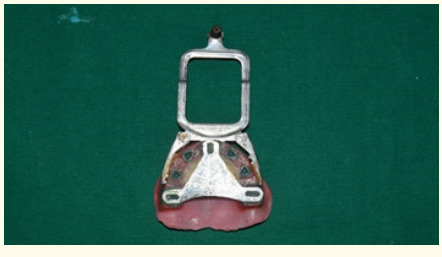

Figure 4A: Tracer assembly attached to the maxillary arch.

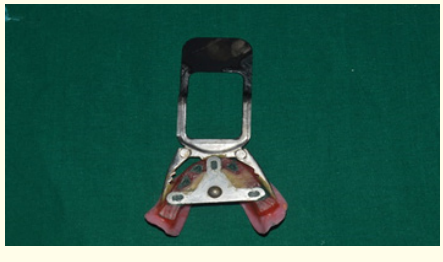

Figure 4B: Tracer assembly attached to the mandibular arch.

(Note the soot, on the tracing platform).

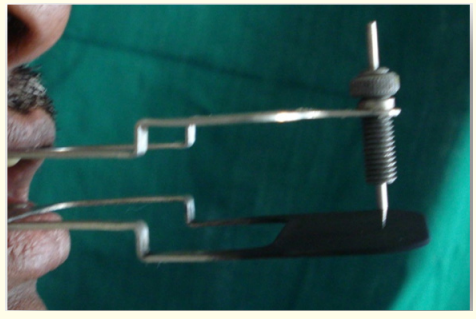

Figure 5A: The entire assembly is tried in the patient's mouth.

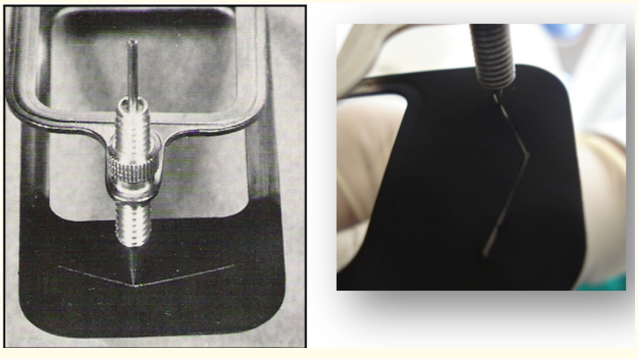

Figure 5B: Representation of the tracing in progress.

Figure 5C: Completed Tracing from the apex where apex represents centric relation.

The central bearing plate is submerged into the maxillary occlusal rim but the shape of which is kept unaltered. Mandibular oc-

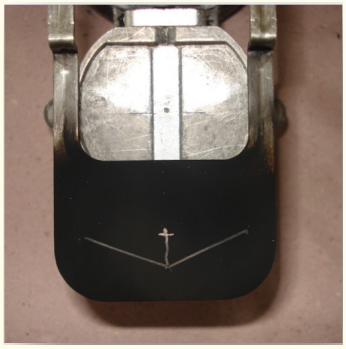

Figure 5D: Tracing with mark 6mm away (On protrusion).

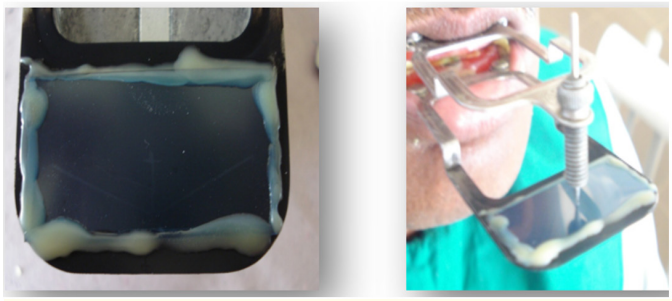

Figure 5E: Plastic sheet is attached to the tracer, with holes placed on the apex and the 6mm mark.

clusal rim height is decreased by 3-4 mm while remaining parallel to maxillary occlusal rim height. The stylus is provided with spring loading so that it can move in a vertical direction to accommodate the approximation of occlusal rims in the protrusive position (Figure 5).

The central bearing point is in the form of a sphere so that it maintains contact when the mandible protrudes; the condyles translate and the anterior portion of the occlusal rims get approximated. If the central bearing point is not a sphere this movement will not be accommodated and even closing force distribution is not taken place. Nearly optimal distribution of contact pressure is maintained between the base plates and the supporting mucosa because of the central bearing. In order to ensure the integrity of the base plates and consistent vertical contact, it is crucial to apply the force uniformly to the basal structures.

The patient is instructed to perform only protrusive and retrusive movements after the entire assembly has been installed and checked on the articulator. Only after consistency at the centric relation point is obtained, the patient is asked to make excursive movements, one after the other. The patient is first asked to make the right lateral and come back to centric then the left lateral and back to centric position. Patients, if trained a few times, will be capable of making a tracing in a singular line. It has an arrow point that represents the centric relation [4].

The eccentric records are not made at extreme positions and are made 6mm away from centric because [5].

- The normal functions are performed within 6mm.
- The articulator will be optimally sensitive to be programmed for a horizontal angle and bennet angle only at a 6mm distance or above.
- Condyles will be positioned too anteriorly, beyond 6mm, resulting in a reduction of horizontal angle while programming the articulator (Figure 5D).

A plastic sheet on the tracer platform is attached and a hole is made, corresponding to the apex and another one corresponding to the 6mm mark on protrusive tracing. Later, place the assembly in the patient's mouth and guide the patient such that the scribbler/stylus falls in the hole in the plastic sheet corresponding to the apex of the tracing.

Plaster is injected between the rims, and allowed to set. Once set, retrieve the centric record. Similarly, make the patient protrude the mandible and guide the mandible such that the stylus falls into the hole corresponding with the 6mm mark. A protrusive record is achieved (Figure 5E).

Materials used for recording the tracing

Through the time, various materials have been used in order to record the tracing produced by the patient with the help of the gothic arch tracer. Some of the popularly used materials include-

- Soot (carbon)
- A mixture of zinc oxide eugenol and spirit
- A mix of chalk and denatured alcohol

- Wax- carding wax, thin film of inlay wax
- Marker pen
- Crayon
- A thin layer of okelson spray may be used (contrast medium)
- Magic slate, as a medium for recording
- Digital tracing

The Ney excursion guide

When the tracing is being performed by the tracing unit, with the operator instructions - leading to certain movements and then only then the recording is achieved. These are border movements executed by the mandible (Figure 6).

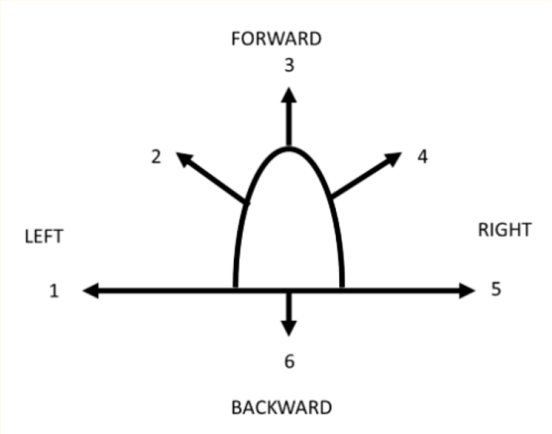

Figure 6: Ney Excursion Guide.
(The movements should be done according to the numbers).

Border movements are noted when the mandible moves through the outer range of motion and are reproducible and in describable limits.

Traditionally, a Gothic arch tracer has been used to record mandibular movement in the horizontal plane. As the mandible moves, the stylus generates a line on the recording plate that coincides with this movement. The border movement of the mandible in the horizontal plane can therefore be easily recorded and examined.[6] When mandibular movements are viewed in the horizontal plane, a rhomboid-shaped pattern can be seen that has, four distinct movement components and a functional component (Figure 7).

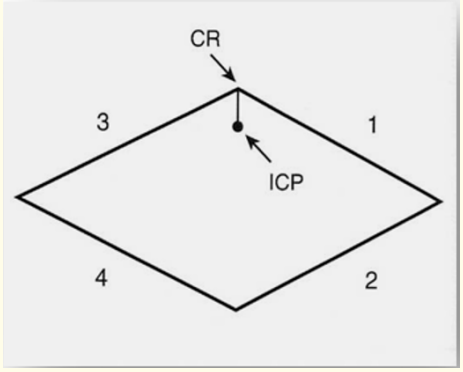

Figure 7: Horizontal Plane Border Movements.

- Left lateral border
- Continued left lateral border with protrusion
- Right lateral border
- Continued right lateral border with protrusion

Confirmation of the correct occlusal position to the articulator [7].

If the apex of the gothic arch tracer coincides with the previously established jaw relationship, it will confirm that a correct horizontal jaw relationship has been transferred to the articulator.

By using a needle-point tracing, it is simple to show the reasoning behind the choice of the "most retruded unstrained position" (the position of centric relation) as the starting point for the treatment of malocclusion, occlusal reconstruction, and denture fabrication. The apex of initial tracing will typically be rounded rather than having a distinct apex when done on a patient with a normal temporo-mandibular joint in order to establish centric relation (Figure 8). In addition to the technical factors, the rounded apex can also be caused by the patient not understanding what is necessary during the right and left lateral movements, habit (also known as acquired eccentric), or a minor filling in of tissues behind one or both of the condyles.

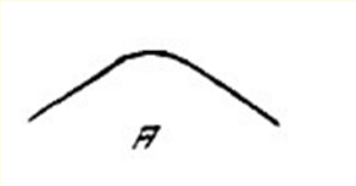

Figure 8A: Blunted apex, usually obtained in the initial attempt to make the tracing.

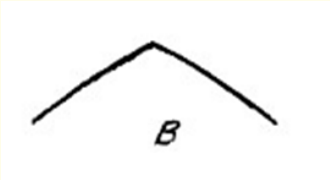

Figure 8B: A properly apexed tracing.

If occlusal reconstruction, adjustment of occlusal disharmony of natural teeth, or denture fabrication had been finished, the blunted apex of the needle-point tracing would be regarded as the place of centric relation. Every time the patient voluntarily chose to close in the more retruded position during occlusal reconstruction, a clear malocclusion would result (Figure 9).

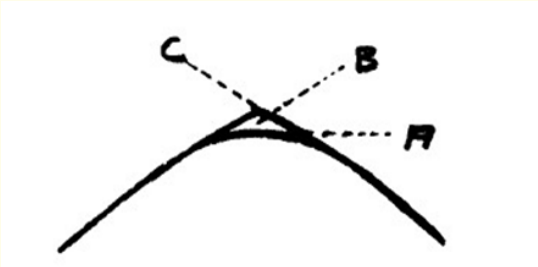

Figure 9: A: Blunted apex of the tracing. B: The area of malocclusion which would result, if A were

accepted as the position of centric relation. C: Apex of the tracing.

The area of malocclusion that would arise in complete denture construction would inevitably cause the bases of the dentures to shift and slide, leading to instability of the dentures and all of its unfavorable side effects.

Classification Of Arrow Point Tracing [8].

- **Typical**: Clearly defined apex with a lateral component that is symmetrical on the left and right. The Gothic arch angle is approximately 120 degrees, demonstrating a healthy TMJ with balanced muscle guidance and no obstructions to the condylar path. With symmetrically balanced muscle guidance, the symmetrical morphology suggests the unhindered movement of the condyle in the fossa and the distal slope of the eminence.
- **Flatform**: It resembles a typical arrow tip, but its left and right lateral tracings are more obtuse. This specific style of arrow point denotes a significant lateral displacement of the condyle within the fossa. More than 120 degrees is the angle of the Gothic arch.
- **Asymmetrical form**: The left and right tracings meet together at an arrow point, but one of them has a shorter inclination to the protrusive route. This type of tracing denotes a restriction of forward motion, either in the left or right joint.
- **Apex absent/round form**: Here, the tracing is rounded rather than having a sharp arrow point. It exhibits weak retrusive movement. Repeated tracing is necessary to get a definite arrow point. Training of patients is required in such cases.
- **Miniature arrow point**: Here the extension of tracing is considerably less than the conventional arrow point. This could be a result of limited mandibular movements, incorrectly seated record bases, or uncomfortably fitting record bases during registration. Additionally, it is a sign of a prolonged edentulous interval accompanied by condylar movement inhibition.
- **Double arrow point:** This is because of habitual and retruded centric relation. This enables patient practice and repetition until one Gothic arch is achieved. It can also happen when the vertical dimension is changed during registration.

- **Dorsally extended arrow point**: The protrusive path continues past the apex of the gothic arch. This denotes a stretched, forced movement of the lower jaw that was either caused by the patient or the operator.

Evaluation of gothic arch tracing

Classical, pointed form

A smooth joint movement sequence and consistent muscle guidance are shown by this symmetry.

Classical flat form

Means that the condyles in the fossa are moving in definite lateral directions.

Weak Gothic arch tracing

Here, the tracing shows sloppy and careless execution of the movements.

Repeating the registration is required. The patient must be required to make stronger movements.

Assymmetrical form

This tracing shows a clear obstruction of forward movement in the joint.

Miniature gothic arch tracing

The tracing indicates cramp-like movements, painfully ill-fitting record blocks, a long-term edentulous state with restricted joint movement, and improperly fabricated.

Vertical line protrudes beyond the arrow point

Either pushing or forcibly retracting the mandible causes this tracing to appear. The Gothic arch might have been created with a protruding mandible, though.

Limitations of graphic method

- When there are healthy edentulous ridges and a normal interarch relationship, the gothic arch tracing approach is preferable.
- In overly resorbed and flabby ridges, arrow point tracing is challenging because the recording bases become unstable, which limits its application.
- When the interarch distance is insufficient, the graphic method is not advised since it is impossible to accommodate the tracing device without increasing the vertical dimension.
- In people with TMJ arthropathy, a sharp arrow tip cannot be seen. In these situations, an alternate solution is the traditional wax closing method.
- In patients with habitual centric, the intraoral gothic tracing method is suitable.
- By avoiding occlusal contact with the occlusal rims when using the gothic arch tracing technique, the stylus removes the habitual neuromuscular memory or engram. Thus the lower jaw will unable to slide forward and laterally.

Conclusion

An important and necessary procedure is the precise recording and accurate transfer of the patient's jaw relation records to the articulator. Failure of the prosthesis will result from improper relationships between the maxilla and mandible. The best-known technique for capturing the centric relation is unknown. Throughout, clinical evaluation, checking, and even rechecking must be done, regardless of the method used. Treatment efficacy depends on careful analysis, case selection, and procedure execution.

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