Critical evaluation of methods to record centric jaw relation

Review Article

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ABSTRACT

Centric relation is the most difficult, yet, most important step in treating edentulous patients with complete dentures. However, a review of dental literature reveals that the philosophies and methods to make the actual registration vary greatly. It is generally agreed that centric relation records can be grouped into four categories- direct checkbite (interocclusal) recordings, graphic recordings (intra-oral and extra-oral), functional recordings, and cephalometrics. This article discusses the pros and cons of the various methods and techniques of recording centric jaw relations. However, the skill of the dentist and cooperation of the patient are probably the most important factors in securing an accurate centric relation record.

KEY WORDS: Centric relation, direct recording, gothic arch tracing, functional recording

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INTRODUCTION

The rationale behind recording Centric Relation records is to establish guidelines as starting point to develop occlusion, with artificial teeth, in harmony with various structures of masticatory apparatus including TMJ. It aids to maintain physiologic and anatomic health of tissues. When maximum intercuspation coincides with centric position, it provides stability, to the prosthesis and thereby, preservation of the health of remaining tissues (edentulous foundation, remaining natural teeth, musculature and TMJ) is accomplished.

Classification of the methods of recording centric relation [Graph 1]:

CENTRIC RELATION RECORD METHODS - REVIEW AND EVALUATION

Based on various methods of recording Centric Relation records a review and evaluation of these methods is presented:

Direct check-bite inter-occlusal recordings:
The direct inter-occlusal record is the oldest type of Centric Relation record. The inter-occlusal check record method is referred to as a Physiologic Method. Normal functioning of the patient's proprioception and the tactile sense is essential for an accurate record. Visual acuity and the sense of touch of the dentist also enter into the making of a Centric Relation record using the physiologic method. This phase of the procedure is developed with experience and is exceedingly difficult to teach to another individual.

Graph 1: Methods of recording centric relation

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"In 1756, Phillip Pfaff,[1] the dentist of Fredrick the Great of Germany, was the first to describe this technique of "taking a bite." Until the end of nineteenth century it was the most commonly used method.

The direct inter-occulusal record, during that period, was a non-precision jaw record, obtained, by placing a thermoplastic material, usually wax or compound, between the edentulous ridge and having the patient close into the material. This was known as the "Mush, "Biscuit", Or "Squash" Bite. "One early method was to adjust the occlusion rims to the chosen vertical dimension of occlusion, have the patient close in a retruded position, and attach the rims together for mounting on an articulator.

"In 1954, Brown [2] recommended repeated closure into softened wax rims. Greene [1] had his patients hold their jaws apart for 10 seconds to fatigue the muscles and then had them snap the rims together. He then made lines in the rims to orient them after removal from the mouth.

Gradually, these procedures evolved into inter-occlusal records as they are usually done today. Small amounts of wax, compound, plaster and Zinc-Oxide Eugenol Impression paste were placed between the occluding rims, and the patient closed the jaws into centric relation. These improvements were an attempt to equalize the pressure of vertical contact.

Indications:
Interocclusal check record is particularly indicated in following situations:

- Abnormally related jaw.
- Supporting tissues that are excessively displaceable.
- Large awkward tongue.
- Uncontrollable or abnormal mandibular movements.
- Occlusion of teeth in existing dentures.
- It is the most practical and acceptable method to check teeth arranged as trial dentures.

CRITICAL EVALUATION

There are many opinions regarding the best material for inter-occlusal record.

"Trapozzano,[3] in 1955, stated that the wax "Check-bite method" is the technique of preference in recording and checking centric relation.

"Schuyler,[1] in 1932, observed that if the recording medium was not of uniform density and viscosity, uneven pressure would be transmitted to the record bases which would cause disharmony of occlusion. He said modeling compound was preferable to wax for occlusal records because it can be softened more evenly, cools slower, and doesn't distort as much as wax.

"Payne,[4] in 1955, and Hickey,[5] in 1964, stated a preference for Dental Plaster because less material had to be placed in the patient's mouth for the record.. Wright,[1] in 1939, described the four factors he believed affected the accuracy of records:

- Resiliency of tissue
- Saliva film
- Fit of bases
- Pressure applied

He concluded that since the dentist wouldn't control the pressure at which the record was made, the best technique would be to record occlusal record at zero pressure. It could thus be duplicated. Hanau[6] in 1923, considered various factors that influenced the recording of Centric Relation and he modified the intra-oral wax method. He pointed out the "Resiliency and Like Effect" (Realeff) of the denture-supporting tissues. He advocated making registrations of the positional relationships, under zero pressure, to minimize the error caused by "Realeff".

"Hanau[1], Block[7], and Others[8] agreed with the 'zero pressure' philosophy, Schuyler, Payne and Trapozzano, among others, advocated the use of light pressure.

Criticism of inter-occlusal method of recording centric relation

There has been much criticism of "check-bites" for Centric Relation records. Most of these criticisms were from individuals who favored some type of graphic recordings.

"Schuyler,[1] in 1932, stated that he did not "consider a record secured on compound or wax occluding rims sufficiently free from error to compete with the restorations without additional checks."

"Simpson[1] felt wax records were unscientific and commented that "such methods as holding the jaw back on closing the mandible, elevating the tongue, and having the patient swallow as he closes the jaw, and the like, are condemned for the paramount reason that they are unscientific and always carry with them the fallacy of guess".

"Phillips[1] stated that "in the hands of, by, for the largest majority of operators, it is worse than useless".

"Gysi[1] tested this method on manikins and never got the same recording twice with wax or compound, He concluded that the uneven cooling of the material

produced distortion.

"Schuyler[1] stated that when records were made using compounds, the uneven or premature contact of areas of occluding surfaces, due to uneven thickness or density of occluding rims, may disturb the relation of the record bases.

GRAPHIC METHOD

Introduction

The graphic methods record a tracing of mandibular movements in one plane and an arrow point tracing. It indicates the horizontal relation of the mandible to the maxillae. The apex of a properly made tracing presumably indicates the most retruded relation of the mandible to the maxillae from which lateral movements can take place. Do not confuse this with other graphic tracings made in additional planes. Pantographic tracings, for example, are made in three planes.

Graphic methods are either intra-oral or extra-oral, depending upon the placement of the recording devise. The intra-oral tracings cannot be observed during the tracing; therefore the method looses some of the value of a visible method.

Techniques

"The earliest graphic recordings were based on studies of mandibular movements by Balkwill[9] in 1866. The intersection of the arcs produced by the right and left condyles formed the apex of what is known as the Gothic arch tracing.

"The first known "needle point tracing" was by Hiesse in 1897, and the technique was improved and popularized by GYSI around 1910. The tracer made by GYSI was an extra-oral incisal tracer. The tracing plate coated with wax, was attached to the mandibular rim. A spring-loaded pin or marker was mounted on the maxillary rim. The rims were made of modeling compound to maintain the vertical dimension of occlusion. When a good tracing was recorded, the patient held the rims in the apex of the tracing while notches were scored in the rims for orientation.

Clapp,[1] in 1914, described the use of a GYSI tracer which was attached directly to the impression trays.

Sears[1] used lubricated rims for easier movement. He placed the needle point tracer on the mandibular rim and the plate on the maxillary rim. He believed this made the angle of the tracing more acute and more easily discernible. He would then cement the rims together for removal.

Phillips,[1] in 1927, recognized that any lateral movement of the jaw would cause interference of the rims which could result in a distorted record. He developed a plate for the upper rim and a tripoded ball bearing mounted on a jack screw for the lower rim. The occlusion rims were removed, and when the patient had produced the proper extra-oral tracing, softened compound was inserted between the trial bases. This innovation was termed the "central bearing point".

In 1929, Stansbery[1] introduced a technique which incorporated a curved plate with a four-inch radius (corresponding to Monson's curve) mounted on the upper rim. A central bearing screw was attached to the lower plate with a three-inch radius curve (reverse-Monson curve). After the extra-oral tracing was made, plaster was injected between the rims to form a biconcave centric registration.

Hall,[1] in 1929, used Stansbery's method but substituted compound for Centric Relation record.

Later, graphic recording methods used the central bearing point to produce the Gothic arch tracing. Hardy[1] and Pleasure[10] described the use of Coble Balancer, and Hardy later designed a modified intraoral tracer similar to the cobles. Hardy and Porter, in 1942, made a depression with a round bur at the apex of the tracing. The patient would hold the bearing point in the depression while plaster was injected for the centric record.

Pleasure,[10] in 1955, used a plastic disk attached to the tracing plate with a hole over the apex of the Gothic arch. The Centric Relation record could then be made without a change of vertical dimension.

Various tracing devices were designed by Hights, Phillips, Terrel, Sears, House, Misserman and others.[1,11] The Sears recording trivet had an intra-oral central bearing point and two extra-oral tracing plates. The maxillary and mandibular tracing arms were locked into centric relation with two lumps of plaster.

Silverman[12] in 1957, used an intra-oral Gothic arch tracer to locate the "biting point" of a patient. The patient was told to bite hard on the tracing plate. This developed the functional resultant of the closing muscles which would retrude the mandible. The indentation made by the patient would be used for the centric record whether or not it corresponded to the Gothic arch apex.

Chandrasekharan Nair[13] developed Chandra tracer. Nandini *et al*[13] conducted – " a comparative evaluation of hight tracer, Chandra tracer, intra-oral tracer,

functiograph and check-bite" and they found that there was no significant difference between height tracer, Chandra tracer, intra-oral tracer, functiograph and check-bite method.

Important factors in graphic recording method

When any graphic tracing is made, these factors are important:

1. Displacement of the record bases may result from pressure if the central bearing point is off center, when the mandible moves into eccentric relations to the maxillae.
2. If a central bearing device is not used, the occlusion rims offer more resistance to horizontal movements.
3. It is difficult to locate the center of the true arches to centralize the forces with a central bearing device when the jaws are in favorable relation and far more difficult if the jaws are in excessive protrusive or retrusive relation.
4. It is difficult to stabilize a record base against horizontal force on residual ridge that have no vertical height.
5. It is difficult to stabilize a record base against horizontal forces on tissues that are pendulous or otherwise easily displaceable.
6. It is difficult to stabilize a record base or bearing device with patients who have large awkward tongues.
7. Recording devices are not usually considered compatible with normal physiologic simulation in mandibular movement.
8. The tracing is not acceptable unless a pointed apex is developed, a blunt apex usually indicates an acquired functional relationship and a sharp apex usually indicates the position of centric relation.
9. Double tracings usually indicate lack of coordinated movements or recordings at a different vertical dimension of jaw separation. In either event, additional tracings are necessary.
10. A graphic tracing to determine Centric Relation is made at the predetermined vertical dimension of occlusion. This harmonizes Centric Relation with centric occlusion and the antero-posterior bone-to-bone relation with the tooth-to-tooth contact.
11. Graphic methods can record eccentric relations of the mandible to the maxillae.
12. Graphic methods are the most accurate visual means of making a centric relation record with mechanical instruments; however, all graphic tracings are not necessarily accurate.

This record should be checked with an inter-occlusal check record when the anterior teeth are arranged and the wax is contoured.

Critical analysis of graphic recording methods

Intra oral v/s extra oral graphic recording methods

The intra-oral tracings cannot be observed during tracing; therefore the method loses some of the value of a visible method; however, extra-oral tracings are visible while the tracing is being made. Hence, the patient can be directed and guided more intelligently during the mandibular movement.

Since intra-oral tracings are small, it is difficult to find the true apex. The tracer must be definitely seated in a hole at the point of the apex to assure accuracy when injecting plaster between the occlusion rims. If the patient moves the mandible before the occlusion rims are secured, the records shift on their basal seat; destroying the accuracy of the record. In extra-oral tracing, the stylus can be observed in the apex of the tracing during the process of injecting plaster between the occlusion rims.

Graphic recordings - praise and criticism

Hanau[1] in 1923, wrote. "The most naive of our genius had intuitions, moulded into metal, attached a decorative theory onto their accomplishment and, it must be admitted, they found a goodly number of fanatical believers and blind followers, whose mental inertial probably did not care to penetrate even the polish of the nickel-plated instrument under consideration".

In 1927, Hanau[1] conceded that the Gysi tracing was satisfactory to check records, but that universal usage was not good.

Tech,[1] in 1926, stated that the Gysi tracing technique was the only means that should be used for centric records and all other methods were "mere deceptions and playthings".

Gysi[1] in 1929, concluded that his tracing technique had only a five-degree error, whereas wax and compound bites had a 25-degree error.

Granger[14] in 1952, insisted that needle point tracing is not a reliable means of determining centric relation since it is recorded in a horizontal plane only. He believes that Centric relation should be considered a vertical rotational relationship related to the hinge axis.

Brill,[15] in 1957, claimed that the retruded position of the mandible (stylus at the apex of the tracing) does not coincide with the maximum inter-cuspation in all persons.

Trapozzano[3] in 1955, insisted that the retruded unstrained relation is the only proper position and that the position is constant throughout the life.

Boos[16] in 1952, claimed that 35 per cent of 400 subjects had their "best" centric position 1 to 7 mm distal to the apex of the Gothic arch tracing.

Brown[2] believes that the needle point tracing is unreliable and recommends repeated closures into wax under close observations.

Moylan, in 1953, wrote. "The apex of the Gothic arch is full of vagaries".

The National Society of Denture Prosthetics reported that "the use of the needle point tracing device for the purpose of determining and checking centric jaw relation is recommended as being both scientific and practical. This society recognizes no other means of verifying centric jaw relationships."

Payne[4] in 1955, described the intra-oral tracer as, "difficult to see and does not work as well where flat ridges or flabby tissue occur. Extra-oral tracing provides visibility but retain the other difficulties if central bearing plates are used. The more equipment we put into the mouth, the more difficult it is for the patient."

Kingery[17] in 1952, pointed out several drawbacks in the use of the central bearing point and added that the "central bearing point allows for no control over the amount of closing pressure applied by the patient."

Phillips[6] pointed to various errors produced by Gysi's [17] technique and stated that, "if one occlusal rim is allowed to touch the other during the lateral extreme positions, undue pressure is bound to be exerted on the contact side, and on account of resiliency of the underlying tissues the side not in contact will be unseated just enough to cause a false reading for the horizontal inclination of the condylar path".

Smith, in 1941, also pointed out drawbacks in the method where vertical dimension was maintained by occlusal rims, commenting that, "the contacting surfaces of the bite rims will not glide easily upon each other, horizontal stresses are set up and the shifting of the bases may easily occur, and under these conditions, it is difficult for the patient to make accurate recording.

Criticism of Gothic arch tracing stated that equalization of pressure did not occur, in prognathic or retrognathic patients it could not be used, and flabby tissues or large tongues could cause shift in base.

Functional recordings

Functional records have been described in dental literature as early as 1910 and are based on principle that the patient produces a pattern of mandibular movement by moving the mandible to protrusion, retrusion, and right and left lateral.

Greene[1] in 1910, used pumice and plaster mixture in one of the rims and instructed the patient to grind the rims together. The denture teeth were set to the generated pattern.

Needles[1] in 1923, mounted three studs on maxillary rims which cut arrow tracings into mandibular compound rims. After removal from the mouth, the rims were re-assembled with the functional grooves. House modified the Needles technique and used four styli to make needle point tracings.

Patterson,[1] in 1923, used wax occlusion rims and he cut a trough in the upper and lower rims. These were filled with a carborundum and plaster mixture. The patient would move his jaw and grind the rims until the proper curvature had been established. This would ensure equalized pressure and uniform tooth contract in all excursions.

The functional technique developed by Meyer,[1] in 1934, used soft wax occlusion rims. Tinfoil was placed over the wax and lubricated. The patient performed the functional movements to produce a wax path. A plaster index was made of the wax path and the teeth were set to the plaster index.

Boos,[1] in 1940, used the Gnathodynamo-meter to determine the vertical and horizontal position at which a maximum biting force could be produced. His bimeter was mounted on the lower occlusion rim with a central bearing point against a plate on the upper occlusion rim. Plaster registrations were made with the bimeter in the mouth and the patient exerting pressure. BOOS theorized that optimum occlusal position and the position of maximum biting force would coincide. He also thought that it was essential that all registration be made under biting force so that the displacement of soft tissues which occur in function would occur during bite registration.

Shanahanb[18] in 1955, in his Physiologic technique, placed cones of soft wax on the mandibular rim and had the patient swallow several times. During swallowing, the tongue forced the mandible into its Centric Relation position. The cones of soft wax were moved and the physiologic Centric Relation was recorded.

Bilateral manipulation[19] suggested by Peter Dawson, in 1974, is the method that has been largely utilized by those who adhere to functionally generated path techniques. They have suggested that the condyles do

not always move superiorly, but sometimes, in response to posterior guidance from the operators, they move inferiorly. Because of this clinical observation, they emphasized the importance of superior placement of the condyles in the fossa when attempting to record centric relation.

McCollum[20] and Granger[20] stated that Centric Relation is that position where the mandible rotates around the hinge axis. In securing maxillo-mandibular records, both investigators recommended the use of Chin Point Guidance recommended by Gutchet in 1970 in retruding the mandible. Others who advocated this technique include Kornfeld,[21] Thompson,[19] Aull[22] and Sloan.[23]

Criticism of functional recording method

The functional methods of recording Centric Relation requires very stable record bases. Forces which can dislodge the record bases occur in any method which requires the mandible to move into eccentric jaw position with the recording medium in contact. The record will not be accurate unless the bases are stable.

The displaceable basal seat tissues, resistance of recording mediums, and lack of control of equalized pressure in the eccentric relations contribute to inaccuracy in these methods.

Patients need to have good neuromuscular coordination to participate in the functional methods of recording centric relations and also be capable of following instructions if accurate records are to be obtained.

Cephalometrics

The use of cephalometrics to record Centric Relation was described by Pyott and Schaeffer. Centric Relation and vertical dimension of occlusion were determined by cephalometric radiographs. This method, however, was somewhat impractical and never gained wide-spread usage.

DISCUSSION AND REVIEW OF LITERATURE

Kantor *et al*,[19] in 1972 conducted a comparative investigation on Centric Relation recording techniques by considering the four techniques i.e. swallowing or free-closure, chin point guidance, chin point guidance with anterior jig and bilateral manipulation and concluded that:

- Bilateral manipulation produced the smallest area of displacement of maxillo-mandibular relation record when compared with the other recording techniques tested.
- The most protrusive positions were recorded with free closure or myo-monitor techniques.
- The most retrusive records were produced with the technique of chin point guidance with an anterior jig.
- Centric relation can be located by using any one of many techniques. There is variability in the result obtained by any techniques. Dentists should evaluate and compare their registrations so that an objective technique selection can be made.

Kapur *et al*[6] in 1957, conducted a study - "An evaluation of Centric Relation records obtained by various techniques" using the three standard methods of recording centric relation, i.e. i) the intra-oral tracing procedure (Hardy), ii) the wax registration procedure (Hanau), and iii) the extra-oral tracing procedure (Stansbery) and they came to a conclusion that:

- The intra-oral and extra-oral tracing procedures were more consistent as compared to the wax registration method.
- In patients with flabby ridges, the intra-oral and extra-oral tracing procedure became less consistent as compared to the wax registration method.
- In patients with flabby ridges, the intra-oral and extra-oral tracing procedure became less consistent as compared to their consistencies in patients with good and flat ridges.
- The wax method seemed less consistent than the extra and intra-oral tracing procedure. It showed the least consistency on flat ridges and highest consistency in the flabby ridge groups.
- The difference in consistency between intra-oral and extra-oral tracing procedure was not statistically significant.

Hobo,[24] in 1985, conducted a study "Reproducibility Of mandibular centricity In three dimensions" and used three centric recording techniques: i) unguided closure, ii) chin-point guidance and iii) bilateral manipulation and concluded that:

- Approximately 0.2 to 0.3 mm of the maximum condylar displacement was recorded by three Centric Relation registration methods. The amount of displacement coincided with the freedom reported in the literature.
- Bilateral manipulation showed the most consistent reproducibility and is recommended for Centric Relation registration. The minimal condylar displacement by this technique indicated the existence of point centric position.
- Condylar positions obtained by bilateral manipulation and unguided closure technique were similar antero-posteriorly and superioinferiorly. If the condylar position obtained by unguided closure technique is physiologic, then the position obtained by bilateral manipulation is also physiologic.

- Unguided closure revealed appreciable lateral displacement, which indicates that muscular position is less reproducible laterally, and condylar displacement can be expected.
- Chin-point guidance placed the condyle posteriorly, inferiorly, and right-laterally and is not recommended. Posterior displacement may result in harmful effect on the bilaminar zone, and inferior displacement may cause an occlusal discrepancy.

Martin Henry Berman,[25] in 1960 conducted a study – "Accurate Inter Occlusal Records" and he tested that the resistance of various inter-occlusal recording media and concluded that:

- Accuracy of dental wax inter-occlusal records is questioned. Tests with various waxes indicate that all offer some resistance to closure.
- Zinc oxide eugenol impression paste offers no resistance to closure and possesses many qualities favorable for obtaining.

Lassila[26] in 1986, conducted a study "Comparison Of five inter-occlusal recording material" using silicone putty, polyether, zinc, oxide and eugenol impression paste, eugenol free zinc oxide, acrylic resin and baseplate wax and concluded that:

- The initial resistance of inter-occlusal recording material to closure changed from 0.5N to 13.8N, and a rapid rise in the working time was seen that in all elastomers;
- Resistance offered by wax at 60°C was about 7N
- Volumetric contraction of elastomers in polymerization was clinically slight.
- Dimensional stability of rigid material, acrylic resin, and zinc oxide pastes was good.
- Elastomers maintained reliability for a relatively long time when stored in a tightly sealed plastic bag.

SUMMARY AND CONCLUSION

It is apparent from dental literature that with many opinions and much confusion concerning Centric Relation records, a certain technique might be required for an unusual situation or a problem patient. In the final analysis, skill of the dentist and co-operation of the patient are probably the most important factors in securing an accurate Centric Relation record.

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