

Meta-Analysis of Various Methods of Recording Centric Jaw Relation- A Literature Review

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ABSTRACT

Centric relation is the most difficult, yet, most important step in fabrication of a successful prosthesis. It is a complex relationship which exists in 3 dimensions and variations may occur in any direction – vertical, anteroposterior or mediolateral. Thus, it is essential to record this relationship with the least possible error to obtain a successful prosthesis. However when relating the maxillary and mandibular dental casts, the ultimate accuracy depends on the technique used to record the maxillomandibular relationship and accuracy and dimensional stability of the material

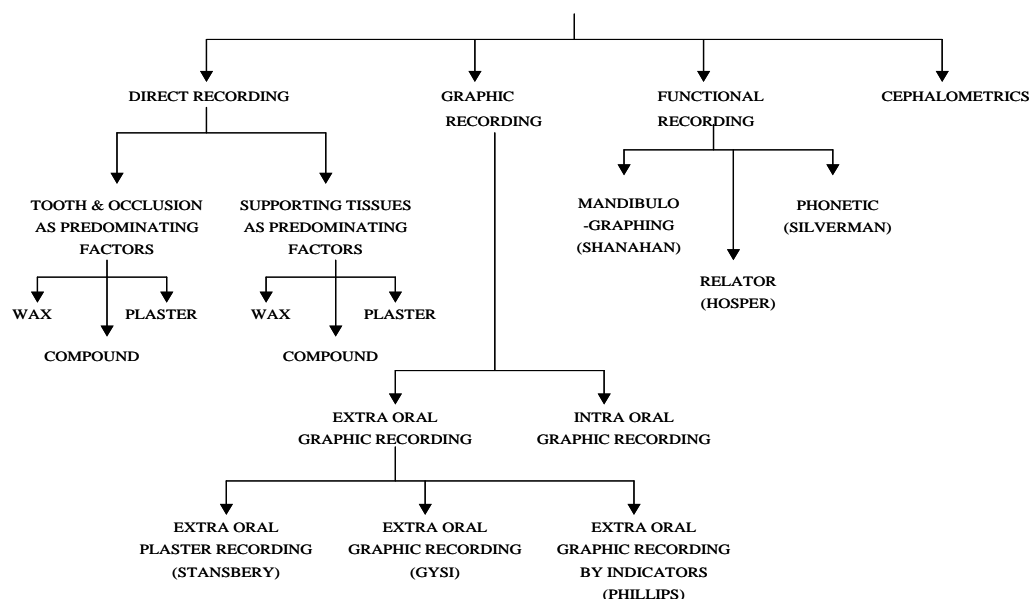
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INTRODUCTION

The rationale of Centric Relation records is to develop an occlusion which is in harmony with the various components of stomatognathic system. When maximum intercuspation is coinciding with centric position, it provides stability to the prosthesis, thereby preserving the health of

remaining tissues (edentulous foundation, remaining natural teeth, musculature and TMJ). The different methods of recording centric relations are classified mainly as:

1. Direct recording
2. Graphic recording
3. Functional recording
4. Cephalometrics



1. Direct Inter-Occlusal Recordings

The interocclusal check record method is also referred as a physiologic method. It is the oldest type of CENTRIC RELATION record. The normal functioning of the patient's proprioception and the tactile sense is essential in the making of an accurate record. The 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.

- In 1756, PHILLIP PTAFF [1] 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 interocclusal record was 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.
- In 1950, GREENE [1] described a mush bite made from modelling compound in which he used a plaster wash to achieve a more accurate record.
- In 1954, BROWN [2] recommended repeated closures 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.

Gradually, these procedures evolved into interocclusal records as they are usually used today. Small amounts of WAX, COMPOUND, PLASTER, 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 jaws.

- Supporting tissues that are excessively displaced.
- Large awkward tongue.
- Uncontrollable or abnormal mandibular movements.
- Check the occlusion of the teeth in existing dentures.

It is the most practical acceptable method to check teeth that have been arranged as trial dentures.

Critical Evaluation

There are many opinions regarding the best material for interocclusal record.

- TRAPOZZANO [3] in 1955 stated that the wax "CHECKBITE 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 pressures would be transmitted to the record bases which would cause a disharmony of occlusion. He said that modelling 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 & 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.
- HANAU [6] in 1929, was the first individually to be concerned about EQUALISATION OF PRESSURE when recording a bite. He wrote, "I attribute the total of the causative factor of denture mobility and consequent change of positional relation to the Resiliency and like Effects of saliva, tissues, restorations, gluey adhesives, and possibly of food interposed between the masticatory surfaces during function." He coined the word "REALEFF", which is formed by the beginning letters of the words "Resiliency and like Effect." This consideration of the resiliency of

the oral tissues became a major factor in “check bite” techniques.

- 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 the dentist wouldn't control the pressure at which the record was made, so the best technique was to record the occlusal record at zero pressure. It could thus be duplicated.

HANAU, [6] BLOCK, [7] and others [8] agreed with zero pressure philosophy. SCHUYLER, PAYNE AND TRAPOZZANO, among others advocated the use of light pressure.

In 1910, GREENE [1] invented his “PRESSOMETER” in an early attempt to equalize the pressure of recording centric relation.

Criticisms Of Interocclusal Method Of Recording Gentric Relation

- SCHUYLER [1] in 1932 stated that he did not “consider a record secured on compound or wax occluding rims sufficiently free from error to complete the restorations without additional checks.”
- SIMPSON [1] felt that 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.

- PAGE [1] said that centric records were “worthless the instant the apposition or the surface were altered.”
- SCHUYLER [1] stated that when records were made using compound, 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.

2. Graphic Method

The graphic methods record a tracing of mandibular movements in one plane, 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. Graphic methods are either intraoral or extraoral, depending upon the placement of the recording devise.

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 HESSE in 1897, and the technique was improved and popularized by GYSI around 1910. The tracer made by GYSI was an extraoral 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 modelling 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 movements 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 tripod ball bearing mounted on a jack screw for the lower rim. The occlusion rims were removed, and when the patient had produced the proper extraoral tracing, softened compound was inserted between the trial bases. This innovation was named the “CENTRAL BEARING POINT”, which supposedly produced equalization of pressure on the edentulous ridges.
- In 1929, STANSBERRY ^[1] introduced a technique which incorporated a curved plate with a 4-inch radius (corresponding to Monson’s curve) mounted on the upper rim. A central bearing screw was attached to the lower plate with a 3-inch radius curve (reverse-Monson curve). After the extraoral 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 cobbles. 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 which was 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, MESSERMAN and others. ^[1, 11] The SEARS RECORDING TRIVET had an intraoral central bearing point and two extraoral tracing plates. The maxillary and mandibular tracing arms were locked into Centric Relation with two lumps of plaster.

- ROBINSON in 1952 designed the EQUILIBRATOR, a tracing device with a hydraulic system and four bearing piston’s one each in the bicuspid and molar region. It produced a functional record of Centric Relation with a uniform distribution of stress over the basal seat.
- SILVERMAN ^[12] in 1957, used an intraoral 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] found that there was no difference between hight tracer, Chandra tracer, Intraoral tracer, Functiograph and Check bite method.

Critical Analysis Of Graphic Recording Methods Intra Oral V/S Extra Oral Graphic Recording Methods

The intraoral tracings cannot be observed during the tracing; therefore the method loses some of the value of a visible method. While the extraoral tracings are visible while the tracing is being made. Hence, the patient can be directed and guided more intelligently during the mandibular movements.

Since the intraoral 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; this destroys the accuracy of the record. While 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, and no hole is required

The graphic recordings, received much praise and criticisms under:-

- HANAU [1] in 1923 wrote, “The most naïve of our geniuses had intuitions, molded 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 inertia 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.
- TENCH [1] in 1926, stated that the Gysi tracing technique was the only means that should be used for centric records, all other methods were “mere deceptions and playthings”.
- GYSI [1] in 1929, concluded that his tracing technique had only a 5-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 horizontal plane only, he believes that Centric Relation should be considered as 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 intercuspation 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 percent of 400 subjects had their “best” centric position 1 to 7mm 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 [7] 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 intraoral tracer as, “difficult to see and does not work as well where flat ridges or flabby tissue occur. Extraoral tracings 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 out various errors produced by GYSI’s 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 methods 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 recordings.
- Criticisms of Gothic arch tracing stated that equalization of pressures did not occur, prognathic or retrognathic patients could not be used, and flabby tissues or large tongues could cause shifting of bases.
- ### 3. Functional Recordings
- Functional records were described in dental literature as early as 1910 and are based on principle that the patient produces a pattern of mandibular movements by moving the mandible to protrusion, retrusion, and right and left lateral.
- GREENE ^[1] in 1910, used a pumice and plaster mixture in one of the rims and instructed the patient to grind the rims together. The denture teeth was 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 reassembled with the functional grooves.
 - HOUSE modified the NEEDLES technique and he used four styli to make the 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 contact 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 registrations be made under biting force so that the displacement of soft tissues which occur in function would occur during bite registration.
 - SHANAHAN ^[1188] 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 concluded that posterior should be used sparingly and with great care. They emphasized the importance of superior placement of the condyles in the fossa when attempting to record centric relation.

This bilateral technique employs a specific superior guidance to the mandible by the operator's finger position. At the same time the operators thumbs apply a downward pressure, thereby attempting to seat the condyles in their most superior position. Little effort is utilized in gaining a posterior placement. An attempt is made to obtain an arcing motion of the mandible in its most superior position.

- MC COLLUM [20] & 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 GUICHET 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 that requires the mandible to move into eccentric jaw positions with the recording medium in contact. The record will not be accurate unless the bases are stable.

- The displaceable basal seat tissues, the resistance of the recording mediums, and the lack of control of equalized pressure in the eccentric relations contribute to inaccuracy in these methods.
- Patients not only must have good neuromuscular coordination to participate in the functional methods of recording centric relations but also must be capable of following instructions if accurate records are to be obtained.

4. Cephalometrics

The use of cephalometrics to record Centric Relation was described by PYOTT and SCHAEFFER. The proper 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 & 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.

KRISHAN K. 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 intraoral tracing procedure (Hardy), ii) the wax registration procedure (Hanau), and iii) the extraoral tracing procedure (Stansbery) and they came to a conclusion that:

- The intraoral tracing procedure and the extraoral tracing procedure were more consistent as compared to the wax registration method.
- In patients with flabby ridges, the intraoral tracing procedure and extraoral tracing procedure became less consistent as compared to the wax registration method.
- In patients with flabby ridges, the intraoral 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 intraoral tracing procedure. It showed the least consistency on flat ridges and highest consistency in the flabby ridge groups.
- The differences in consistency between the intraoral tracing procedure and the extraoral tracing procedure was not statistically significant.

SUMIYA HOBBO [24] in 1985, conducted a study “REPRODUCIBILITY OF MANDIBULAR CENTRICITY IN THREE DIMENSIONS” and he used

three centric recording techniques: i) unguided closure, ii) chin-point guidance and iii) bilateral manipulation and concluded that:

- Approximately 0.2 to 0.3mm 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 interocclusal recording media and concluded that:

- Whether dental waxes make accurate interocclusal 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 favourable for obtaining maxillomandibular records.

VEIJO LASSILA [26] in 1986, conducted a study “COMPARISON OF FIVE INTEROCCLUSAL RECORDING MATERIALS” 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 interocclusal recording materials to closure changed from 0.5N to 13.8N, and a rapid rise in the working time was seen in all elastomers.
- The resistance offered by wax at 60°C was about 7N.
- The volumetric contraction of elastomers in polymerization was clinically slight.
- The dimensional stability of rigid materials, acrylic resin, and zinc oxide pastes was good.
- Elastomers maintained their reliability for a relatively long time when stored in a tightly sealed plastic bag.

SUMMARY AND CONCLUSION

It is apparent from the dental literature, that there are many opinions and much confusion concerning Centric Relation records. One would have to agree with Sears who wrote. “The problem has confused a great number of readers, which is not surprising, as many of the writers are also confused.” BOOS probably came closest to the solution when he stated that “In normal cases, the occlusion, the temporomandibular joints, the bone, the soft tissue and the musculature all produce the same relation to each other and any one of the many registration techniques may be used”. A certain technique might be required for an unusual situation or a problem patient. In the final analysis, the skill of the dentist and the cooperation of the patient are probably the most important

factors in securing an accurate Centric Relation record.

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