Prosthodontic rehabilitation of a case of partial anodontia - *A case report*

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ABSTRACT

Partial Anodontia, a congenital disorder characterised by partial absence of teeth, indeed poses as a troubleshooting condition for the prosthodontists. Rehabilitation at an early age of these young afflicted individuals is mandatory for physiologic & psychosocial reasons. Treatment approach of such cases can include fixed, removable or implant supported prostheses used individually or in combination to provide an optimal result. This article discusses a case report that pertains to the prosthodontic rehabilitation of a unique case of partial anodontia with overdentures as a preferred treatment modality.

INTRODUCTION

Human being has long sought to create his own sense of identity. Beauty may be skin deep yet we cannot deny the fact that today esthetics plays a key role in every strata of life and is a major contributor towards the success of an individual.

This case report is about a unique case of partial anodontia in a young female. The uniqueness lies in the fact that though there was congenital absence of teeth, the case did not depict any pathognomonic features of a particular disorder or syndrome.

CASE REPORT

A 24 year old female Ms. Suchitra Surve reported to the Department of Prosthodontics, Nair Hospital Dental College, Mumbai with the chief complaint of severe functional disability & compromised esthetics.

PAST HISTORY

The patient was normal at birth and as per her parents version, there was no family history of any similiar defect / disorder. Her siblings were normal. At the age of 3 years, she had undergone surgery for removal of a maxillary growth, however the details of the record could not be traced. The trauma or surgical brunt to the developing tooth buds could be attributed as the probable cause of her abnormality. The maxillary growth was stunted & very few permanent teeth had erupted. The patient had a old set of partial dentures which she did not wear due to poor fit. For a very long period of time, Suchitra & her parents had not sought for any Medical / Dental advice due to despair & loss of hope.

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EXAMINATION

EXTRA ORAL :- Extra oral examination revealed facial asymmetry. The midfacial region was depressed resulting in a concave profile.

Though no TMJ or masticatory muscle pain was noted, her oral range of motion was deviated.

INTRA ORAL :- Intra oral examination revealed absence of 17 permanent teeth. The maxilla was rudimentary with a flat palatal vault and a post surgical fistula. The mandibular ridge was atrophied. Teeth present :

61	67
876321	8

Due to the peculiar eruption of the teeth, the mandibular arch seemed collapsing resulting in a completely deranged occlusion.

RADIOGRAPHIC EXAMINATION

Orthopantomogram revealed congenital absence of missing teeth & poor bone foundation. Lateral cephalogram was taken at physiologic rest position of mandible to evaluate the interarch space.

SPEECH EVALUATION

Although her speech was intelligible, on patient hearing, she had developed wrong articulation patterns which needed corrective therapy after rehabilitation.

TREATMENT PLAN

The management of the case demanded a multi-disciplinary approach which involved active interplay between a prosthodontist & other health professionals. As in most complex cases, the patient could have been treated in several ways. However due to constraints of feasibility, availability & economy, a need based treatment of overlay dentures was executed.

The rationale behind selection of Overlay Dentures was :-

1. Preservation of existing teeth.
2. Sufficient interocclusal space available.
3. Restoration of lost vertical dimension.
4. A cost effective & easy to maintain design.
5. Easy patient acceptance towards the prosthesis before execution of extensive treatment procedures.

STEPS IN REHABILITATION

Diagnostic casts were made, over which temporary record bases were made. A facebow record was taken and wax

Fig. 1 : Maxillary arch

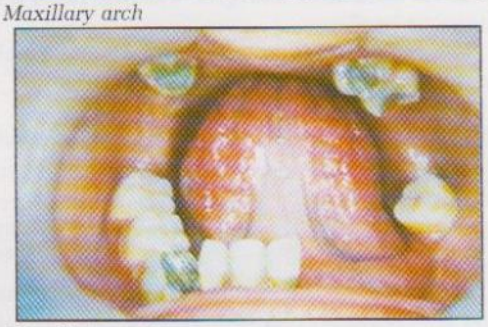

Fig. 2 : Mandibular arch

Fig. 3 : Electromyographic evaluation to determine vertical dimension of rest

Fig. 4 : Cast partial framework tried on maxillary arch

Fig. 5 : Cast partial framework tried on mandibular arch

Fig. 6 : Overlay dentures

Fig. 7 : Overlay dentures in occlusion

Fig. 8 : Patient before rehabilitation

Fig. 9 : Rehabilitated smile

rims contoured as per esthetic demands. Obtaining an accurate jaw relation was indeed a trouble shooting step due to poor retention & stability of record bases. Besides conventional methods, an electromyographic evaluation of masseter & temporalis muscle was carried out to obtain the correct vertical dimension of rest.

An overlay denture with metallic denture base was planned and a wax pattern was made after surveying the cast & utilizing the available undercut areas for retention. It was a totally noninvasive procedure with no tooth preparation involved. The cast partial design was not a conventional one but was indigenously designed as per the demands of the case. An appropriate occlusal scheme was given using a semiadjustable articulator. A setting trial was taken & wax contours modified to achieve fullness of cheeks & lips to improve her profile. At the time of denture delivery a fluoride therapy was carried out to preserve the existing teeth. The patient was educated and made conscious of the maintenance of meticulous oral hygiene. A periodic recall of the patient every 6 months is still being observed till date.

DISCUSSION

Preservation of existing teeth & alveolar bone is imperative in individuals with partial anodontia. When there are teeth present for support, overdentures are the most desirable treatment option for these patients Crum[2] has provided an excellent overview of the advantages of conventional overdentures. The rationale behind selection of overlay dentures in treating the case discussed here, was preservation of existing teeth & easy patient adaptation to the prosthesis. The non-conventional indigenous cast metallic framework design of the denture base provided good retention. Regular fluoride therapy would preserve the existing health of the teeth. Periodic recalls observed in these cases are a must for long term success.

SUMMARY

Management of troubleshooting cases like partial anodontia indeed demands a multidisciplinary approach. In this case, a need-based treatment approach was observed. Prosthodontic rehabilitation of this case not only improved function and esthetics dramatically but also psychologically boosted the morale of the patient giving her a turning point in her life.

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Abstract

Dental photography in support of patient documentation and communication

Intraoral conditions, which in the course of dental treatment are subject to change, can be recorded in details by means of photography. Pictures provide an improved documentation and the option of monitoring particular situations over longer periods of time. We propose a standardised preoperative 35-mm photographic series, for intraoral photography, special intraoral mirrors and lip and cheek retractors are modified as needed. Macro 35-mm cameras with macro flash are by now well-established. Such equipment combined with the technique outlined in this report make standardised photographic documentation possible without mouth-angle retractors and mirror rims obstructing the view. In addition to radiographs a photographic archive will provide one way to record detailed assessment of minor changes in hard and soft tissues over longer periods of time & also offers the dental team unbiased records for evaluation of treatment quality. It allows for patient advice based on their individual treatment outcome and, at the same time, it presents the team's individual profile. The ability to produce documentary photographic records of patients make it easier to present cases in study groups or in lecturers and dental publications and to enter into a progressive communication with colleagues.

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Cranio-mandibular relations - Determinant II : Centric jaw relation

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ABSTRACT

The foremost consideration in recording horizontal jaw relation in Prosthodontic procedures is to obtain a base line from where it is possible to relate the mandibular movements in an articulator. Since mandibular movements terminate in this base line position, it provides a starting point to build occlusion on the dentulous and edentulous casts. This base line position of mandible corresponds to the stationary opening and closing axis or the hinge axis position of the mandible and it can be obtained by recording the hinge axis. This border position of the mandible is referred as centric relation. Since it is a terminal position it is easily reproducible. Centric relation is a complex term, which denotes a condylar and a mandibular centric, as well as a static, passive centric and a dynamic power centric. To comprehend this term better, a function oriented or purpose based definition of this relation should precede the controversial location based anatomical definition. Regardless of the changing definitions on the location of condyle in centric relation, the significance of centric relation has always remained the same.

INTRODUCTION

The innumerable definitions of centric relation that have appeared in the past century have in common emphasized a retruded concept[1-13], while the present definition proposed by the Academy of Prosthodontics in its GPT 7[14] towards the end of the century, define it as a maxillo-mandibular relationship with an anterior-superior positioning of the condyle-disc complex on the slopes of the articular eminence. Surprisingly, the earlier definition of a retruded theory nor the current definition of an anterior-superior bracing of the condyles has neither significantly changed the objective nor the procedure of recording centric relation in complete denture construction.

Features and significance of centric relation

1. Centric relation is the ideal arch to arch relationship and an optimum functional position of jaws for the health, comfort and function of the TMJ and musculature[15].
2. It is a mandibular position where the condyle-disc assembly is seated in anterior-superior position against the posterior slope of articular eminence, which hitherto it was believed by many to be the rearmost, upmost, midmost position in the glenoid fossa. (RUM Position).
3. Centric relation of mandible is a hinge position[1]. In centric relation condyles exhibit only pure rotation without any translation.
4. Mandibular movements return or terminate in centric. It is thus a reproducible position and therefore serves as a reliable reference to develop centric occlusion in artificial dentures. It is a starting point for the arrangement of artificial teeth in articulator to develop maximum intercuspation in complete dentures.
5. It is a position where upper and lower teeth are braced against each other during deglutition[10,16,20].
6. It serves as a reference position for occlusal reconstruction in dentulous situations[17].
7. It is a posterior border position and the posterior limit of the envelope of mandibular motion[6].

   To summarize; centric relation is a reproducible, recordable, consistent reference position, and a physiologically acceptable position for deglutition.

CENTRICITY OF CENTRIC RELATION

The term centric relation was derived from the word "center" or "center oriented relation". Condylar centricity, was first proposed by Gysi[13] and later accepted by several authors, particularly Gerber[19] who described it as a "Zenith of the fossa" relation. While suggesting the present definition in 1987, the Glossary in its 5th edition has stated that this term centric relation is in transition to obsolescence[18]. Without assigning a substitute term, the glossary has however retained it in the subsequent two editions. The 'word' centric is perhaps objectionable as the condyles are not considered to be located in, at or directed toward the center of glenoid fossa nor occupy the central deepest position in the glenoid fossa as claimed earlier.

Whether the centric location of condyle in the fossa is presently accepted or not, centric jaw relation is the central position or a hub for mandibular movements. Hence it will be difficult to dispense the term "centric relation" nor can it be substituted appropriately by another term.

Key words : *Centric relation, gothic arch, hinge axis*

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AN EXPOSITION OF CENTRIC RELATION

A. Two dimensions of centric relation - Dual centric

Centric relation should be understood as a complex term with a condylar and mandibular dimension. The condylar centric position should be differentiated from mandibular centric position.

i. Condylar centric position, is a condyle disc-fossa/eminentia relationship

ii. Mandibular centric position, is a maxillo-mandibular relationship

Both these components of CR co-exist. Collectively it is known as centric relation. The proponents of the retruded concept of centric relation believed that both condylar centric and mandibular centric were retruded positions. while the anterior superior concept of centric relation opposed the retruded condylar position and stated that the condyle disc assembly is braced antero-superiorly against the posterior slopes of articular eminence. The condylar position during centric maxillo-mandibular relation is superior-anterior and not retruded as believed earlier. The dispute is not the mandibular position in centric relation. but its condylar position.

During centric jaw relation position, the condyles are seated in a superior-anterior position against the slopes of eminentia and not in a retruded position, while the mandible is in its posterior terminal position directed anterio-superiorly. Unless the mandible functions from its terminal position it cannot be a reproducible and consistent position. If this is accepted, than there is no confusion between the two definitions.

B. Two definitions of centric relation

i. **Anatomical or location based definition**

Nearly all the definitions of centric relation are topographical. which either attempt to describe the anatomical location of the condyles when mandible is in centric relation or the position of mandible in centric relation. All the seven definitions given in GPT 7 are location oriented. These location-based definitions provide information as to how to secure this position of the lower jaw. Besides this, it has no importance. They do not explain why and how centric relation is important in Prosthodontic procedures and what are the consequences if it is incorrectly recorded in a Prosthesis.

For example. the AS position of the condyle or the most retruded or posterior relation of the lower jaw to the upper jaw as defined by Boucher[12] and few others including the GPT-3 apparently is useful only to record this position.

To understand centric relation, a reason or purpose based description of this term is needed. The objective of recording centric relation is necessary to comprehend it usefulness. After having visualized the importance of this relation, a location based definition will certainly help to record this relation. The anatomical definition should therefore complement a purpose-oriented definition.

ii. **Significance based definition**

A functional definition of centric relation explains why centric relation is important. The definitions of centric relation given in GPT and by others are anatomical definitions, which describe only about the location of condyles or the mandible in centric relation. As an example, the anatomical definition of GPT 7 is only a guide to indicate the status of condyles.

Dawson[13] aptly describes centric relation as "If we were asked to select the one arch to arch relationship that is most important to comfort, function and health of the gnathostomatic system, we would have to say without reservation, it is the centric relation position of the mandible". No other position of the mandible can satisfy this requirement to build occlusion in complete dentures or in occlusal reconstructions.

If this position is not recorded correctly, complete dentures cannot efficiently function. Complete dentures should occlude in centric occlusion when the jaws are in centric relation. Otherwise instability of dentures, intolerance of alveolar ridge and impaired masticatory performance would result.

The clinical importance of accurately recording this position of the mandible and the consequences of incorrect centric relation should be defined before defining the anatomical relationship of the condyle to the fossa or the mandible to the maxilla.

So far, no other term in dentistry has been periodically defined and redefined like centric relation. The Academy of Prosthodontics which is the oldest Prosthodontic organization of the world has been constantly revising the definition of centric relation in its glossary. It is probable that sooner or later the present definition is also likely to undergo a metamorphosis.

Hopefully, the next definition of the future will include the significance of centric relation, while presenting yet another location oriented definition.

C. Two characteristic features of centric relation

The definition of centric relation has been constantly changing from time to time. It is likely that it may change in the future, but these two features of centric relation will remain constant

i. <u>It is a reproducible position:</u> There are two reproducible or repeatable positions. One is centric relation while the other is the postural rest position of the mandible. Since centric relation is a hinge position, it is a repeatable position.

ii. <u>It is an untranslated hinge position of the mandible[7]:</u> .When the condyles are in centric relation position, condyles are capable of executing only pure rotation movement.

D. Two interpretations of centric relation

Articulator Vs an in-vivo centric relation

A static centric should be differentiated from a dynamic power centric relation.

- static centric relation – An articulator situation with mounted casts
- dynamic centric relation – An in-vivo situation

Centric relation is represented in articulator as a static positional relation of the upper and lower casts at a predetermined occlusal height. While in reality, it is a dynamic relationship of the condyle-disc assembly to the temporal bone during the function of mastication and deglutition. It has been shown that during occlusal loading the articular disc is compressed due to fluid movement, whereas articulators are generally not designed to allow joint compression. Gerber[19] realised condylar compression and distraction of the TMJ and he designed condylator articulator, which could accommodate the resiliency of TMJ (Fig.1).

It should also be pointed that mastication occurs while the mandible is on the way to centric relation[36] within the range of hinge opening and not at the static centric jaw relation position. In centric jaw relation, the masticatory stroke terminates. Mastication of bolus is finished as the mandible reaches centric position[36]. We do not rub or grind the teeth in centric like mortar and pestle. It is only during deglutition centric position is used to brace the mandible against maxilla[4,10] . Ramfjord[20] described centric relation as "Swallow position" and stated that centric relation is acquired mainly when swallowing.

CENTRIC RELATION IS A LOADING POSITION

Centric relation should be interpreted according to loading at the temporomandibular joint. Depending on the loading of the temporomandiblar joint, centric relation should be identified as

i. A passive centric: Seen during passive closure of jaws in centric relation or as projected in the articulator.
ii. A power centric: A dynamic centric observed during mastication and deglutition.

It has been reported that compressive forces acting in the joint are relatively high and the surface of the joint must withstand this load[21,22]. It is estimated that joint forces are more than 2.7 times that of forces on the occlusal table[23]. When the occlusal surfaces of upper and lower teeth are in a passive contact position in centric relation there is no loading on the joint. During mastication and deglutition, loading progresses and the condyles are seated against the avascular aneural central zone of the disc by the contraction of the superior head of external pterygoid and the middle and anterior fibers of temporalis muscle, and this disc condyle assembly is braced against the posterior slopes of eminentia by the contraction of internal pterygoid and masseter[34] (Fig.2). The avascular central zone of disc is ideally suited for loading. Squire[24] described joint behaviour under compressive loading as light, medium and heavy loading and defines centric as passive and power centric according to the intensity of loading.

Hobo[25] described a buffer space or safe space present between condyle and fossa which prevented the transmission of heavy load transferred to the condyle during function. It helped to minimise the direct forces on the disc and protect it from anterior displacement and perforation.

McHorris[26] while differentiating condylar loading stated that while the mandible is in rest position, the condyle disc assembly is very near in same position as centric relation, but at a non-stress bearing uncompromised relationship. It occupied a seated position against disc only during function.

Centric relation has no function – A realistic supposition:

Even though centric relation is considered as the terminal position in the act of mastication, it does not directly contribute to mastication. In reality, teeth do not come in contact during chewing. Thompson[35] has shown that teeth should not and need not contact during mastication and a portion of food bolus is always present between the upper and lower cusps of teeth during mastication.

Earlier, Stuart[36] also claimed that all the functions of the mandible is in front of centric relation. When occlusion is reached, masticatory function is finished. He stated that the closure of the jaws do their function on the way to occlusion. When occlusion or closure is reached, function is already finished. This is also true with centric relation. Masticatory function of the mandible is in front of centric relation before the mandible reaches centric relation. Stuart also mentioned that "by placing interferences, deflections, and premature contacts in the path to centric relation, we disallow full function".

McCollum[1] described centric relation as the most retruded idle position because function is completed by the time jaw reached centric relation position. Ramjford aptly described centric relation to a "polar star", you have to follow it to orient the mandible in the right direction.

Chronology of the changing definitions on the condylar position in centric jaw relation during the past century:

Rear most condylar position. - *McCollum (1920)* - McCollum demonstrated that the condyle executed a pure rotational hinge movement when the operator guided the mandible to position the condyles in the most retruded position in the glenoid fossa. McCollum named this position as centric relation and was the first to record the hinge axis of mandible.

Upmost, rear most condylar position - *Granger (1952)* - A second component namely a most superior position was considered necessary for bracing, since the condyle was unstable when it was only in the most posterior position.

Rearmost, uppermost, midmost condylar position - *Stuart (1969)* - (RUM) position. A medial component was added for a stable condylar position (three-dimensional position). It was considered a physiological condylar position harmonious with centric occlusion. RUM position was later accepted by the International Academy of Gnathology[7].

GPT-4 in 1977 also defined the position of condyles in centric relation as a most posterior.

American Equilibration Society (1977) – It challenged RUM position as it was considered to give pressure on the retrodiscal tissue at bilaminar zone and proposed the most anterior and upper most position of condyle opposite the slope of articular eminentia.

Celenza (1978) –Celenza stated that condyle disk assembly braced superiorly and anteriorly against the posterior slope of eminentia. Presently this is widely accepted as optimum condylar position in centric jaw relation.

American Equilibriation Society (1987) – The AES revised its earlier definition and believed that the condyles articulate with the thinnest avascular portion of the disc in the anterior, most superior position of the dorsal slope of eminentia.

GPT-5 (1987). – The present definition was recommended. GPT –5 gives only one definition describing the new AS position of the condyle.

GPT-6 (1984) and GPT-7 (1999) however gives six other definitions, besides the AS position of the condyle. It does not state whether it is of historical importance or for consideration.

CRITERIA FOR REDEFINING CENTRIC POSITION OF THE CONDYLES FROM RUM TO SUPERIOR ANTERIOR POSITION - *AN ANATOMICAL OVERVIEW*

1. It has been shown that the roof of glenoid fossa is extremely thin and translucent in some dry specimens[27]. There is also no articular cartilage in the glenoid fossa, but there are many minute foramina presumably for the passage of blood vessels and nerves[27]. The "glenoid space" is occupied by the thickened posterior zone of articular disc. This portion contains blood vessels and nerves and therefore not suited for function of articulation[28,29,30].
2. The superior portion of the condylar head is covered with articular cartilage extending forward over the anterior face of the condyles and it is designed for stress. Similarly, the bone trabecular struts on the curved surface of the posterior portion of eminentia are oriented parallel to the direction of forces[31]. This shows the bone of the distal slopes of the articular eminence is designed to withstand stress. Therefore Celenza felt that the posterior slope rather than the glenoid fossa is the articular portion of the joint.
The center of the articular disc which is interposed between the condyle and the posterior slope of the articular eminence is devoid of nerves and blood vessels, indicating a stress bearing portion or functioning area of the disc[29]. While the non stress-bearing thick periphery of the disc is rich in blood vessels and nerves[29,30]. The disc is thickest posteriorly (2.9 mm) and thinnest in the middle part (1.1 mm)[32].
Therefore from an anatomical point of view, neither the roof of glenoid fossa nor the retrodiscal bilaminar zone is considered suitable for articulation or as a stress-bearing site. Rather, the posterior portion of the eminentia articulating with the thin intermediate zone of the articular disc opposed by the anterior face of the condylar head appears to be the most logical functional arrangement for centric positioning of condyles (Celenza, Lucia).
Further in a longitudinal study, Celenza[33] in 1973 re-examined 32 of his best all gold posterior reconstructions restored to centric relation with tripodised centric stops (point centric), several years after insertion, and found that all patients subsequently established a more anterior position. A discrepancy of 0.02 to 0.36 mm between centric relation and maximum intercuspation was noticed.
Therefore Celenza questioned whether RUM position was physiological to the joint and concluded that the superior anterior bracing of the condyle disc assembly against the slope of eminentia was the optimum condylar position in centric. The discrepancy between the two positions is 0.2 mm (Hobo).

Role of musculature in the anterior-superior positioning of condyles in centric relation

Williamson[34] investigated the pattern of muscle contraction in centric relation. From an electromyographic study he found that the contraction of the superior head of external pterygoid, placed the disc in a braced position against the posterior slope of articular eminence and the contraction of temporalis positioned the condyle superiorly in close approximation to the articular disc. This condyle disc assembly was then finally seated against the posterior slope of the articular eminence by the contraction of masseter and medial ptyergoid during centric power closure (Fig.3-4).

The direction of internal pterygoid and masseter during centric closure strongly suggest an anterior-superior positioning of condyle against the eminentia (Fig.4). There is no muscle attached to the condyle to pull the condylar head vertically up toward the centre of glenoid fossa. The temporalis which elevates the mandible is situated anterior to the condyles.

Similarly there is no muscle attached to the neck of the condyle to retrude the mandible from behind (to oppose the action of external pterygoid which is attached anteriorly on the neck of condyle). Retrusion of mandible is done by the muscles which are attached anterior to the joint at the coronoid process (temporalis) and anteriorly in the inner surface of mandible (posterior belly of digastric muscle) (Fig.2).

Condylar position in centric relation – *various opinions by distinguished researchers*

"Condyle belongs to centered position not down or forward on the eminence" – *Barnett*

"I believe there is a range of acceptability. It must be a border position and appears to be most logically positioned at the most posterior position of the tuberculum" - *Celenza.*

Table shows the various occlusal positions in centric relation[37]

Terminology	Interpretation
Jaw Position	
1. Centric relation Syn: Terminal hinge relation	Retruded mandible concept/A-S concept Hinge axis concept
Occlusal Position	
1. Occlusion Syn: Contact Position (CP) Occlusion Position (OP)	Contact between opposing teeth
2. Centric occlusion Intercuspation occlusal position (ICP)	Maximal intercuspated occlusion without any reference to jaw or joint position
3. Retruded contact position (RCP) Terminal occlusion Occlusion in centric relation	Occlusal status in centric relation without any reference to centric occlusion – may or may not be a maximal intercuspation
4. Centric occlusion in centric relation *Syn* :Terminal hinge intercuspal occlusal position (THIOP) Point centric Organic occlusion	An occlusal status in centric relation which is a centric occlusion. Maximal intercuspation in centric relation. Coincidence of centric occlusion with centric relation. Teeth in centric occlusion, jaw in centric relation.
5. Habitual occlusion Acquired centric Mesial intercuspal occlusal position (MIOP) Lateral intercuspal occlusal position (LIOP)	Maximal intercuspation located anterior or lateral to centric relation. Teeth in centric occlusion but mandible not in centric relation. Mesial centric slide, lateral centric slide
6. Long centric occlusion[17] Freedom in centric[38]	The establishment of freedom of movement at the occlusal level between centric occlusion and centric relation when there is non-coincidence of centric occlusion and centric relation. Freedom without interference to close the mandible into centric relation or slightly forward of it.

"Maximum intercuspation of teeth should occur when the condyle disc assemblies are in the most superior position" – *Peter Dawson*

"Midmost, uppermost - *Ash*

"Most superior position in the fossa and in their terminal hinge axis location" – *Henry.M Goldman*

"*Zenith of fossa relation*" - *Gerber*

"Most superior position" – *Guichet*

"Condyles should be braced ant-superiorly against the distal slope of the articular eminence" – *Lucia*

"Anterior upper position" – *Ramfjord*

"Most posterior relation of lower jaw to upper jaw – *Boucher*

"In treatment the condyles should be located in the most retruded midmost, upmost position when teeth are in maximum intercuspation. – *Peter Shaerer*

"Most retruded superior position" – *Weisgold*

"Reproducible border hinge position - *Posselt*

"Most retruded idle position" - *McCollum*

"Rear most untranslated hinge" - *Stuart and Stallard*

"Terminal relation" - *Granger*

Centric relation is the Terminal hinge relation:

During mandibular opening movement, the condyle rotates initially in a hinge and later in a translatory motion. A pure hinge movement of the condyle occurs only when the condyle is in its centric position.

Translation or combinations of translation and hinge movement take place when the condyle moves anterior to centric relation. For this reason, centric relation is known as the terminal hinge relation. Terminal hinge axis is the horizontal axis of the condyles, when the condyles are in centric relation[1,4,7]. According to the Gnathology school, the ability to open and close the jaw in a pure hinge movement can be attained only when the jaw is in its retruded centric position.[7,16] This hinge axis relation is stable and reproducible and hence can be accurately recorded in dentulous and edentulous subjects. The Glossary of Prosthodontic terms-7 prefers the term transverse horizontal axis to the terminal hinge axis of the mandible[14].

Gothic relation is a terminal mandibular position regardless of the condylar position

Centric relation is a baseline position for the termination of mastication and deglutition. Masticatory movements return to centric jaw relation and originate from this position. Swallowing act takes place in this position[20]. Hence line must be situated at a terminal position, if not it will be inconsistent and difficult to locate and record. Therefore, it is logical that centric jaw relation which is a terminal position for mandibular movements should be a terminal position. Posselt[6] also described it as retrusive limiting position

This is further substantiated by the following observations:

1. The Gothic arch tracing does not alter whether one accepts the RUM or A.S centric position of condyles. Gothic arch tracing records a posterior border or terminal position of the mandible and at this mandibular position the condyles are in their superior position in the fossa/eminentia.
2. Both in RUM and AS condylar position (GPT 7[8] condyles are restricted to a pure hinge movement. Hinge movement is therefore common to both interpretations of condylar positions in centric relation.
   The transverse hinge axis (THA) – is not affected whether one considers the RUM or the anterior-superior position of the condyles in centric jaw relation. It is the terminal axis and there is no significant shift in hinge axis between the RUM or AS position of the condyles. The difference between RUM and AS position of the condyles is only about 0.2 mm (Hobo).
3. The manual methods, tongue, phonetic, and swallowing guidances of recording centric jaw relation, that have been recommended in the past to retrude the mandible are still valid and accepted procedures, inspite of the new AS definition of centric relation. If the retruded concept of mandible is rejected, then these techniques of recording centric relation should also have to become obsolete. Similarly, Pantographs will also have no relevance.

significance and inter-relation between centric relation and centric occlusion

1. Centric occlusion is a tooth-to-tooth position, whereas centric relation is a bone-to bone relation. Centric relation serves as a reference position or baseline to nomenclate the various occlusal positions[37,38]. Both may or may not be identical with each other.
2. In persons with natural teeth, both centric relation and centric occlusion exist. After the removal of teeth, centric occlusion is lost, while centric relation remains and serves as a reliable guide to develop centric occlusion in artificial dentures.
3. In dentulous individuals, occlusion in centric relation (RCP - retruded contact position) is not and need not be centric occlusion[3], although it would be ideal to have centric occlusion at centric relation[39,55,56,49]. In edentulous individuals however it is feasible that centric relation and centric occlusion are made to coincide.
4. When centric occlusion does not coincide or is not identical with centric relation, the condyles do not remain in their upper most position in the glenoid fossae, but take a position either anteriorly or laterally. This is referred as "centric slide"[20].
5. Correction of interference between occlusal and condylar centric positions by occlusal reconstruction establishes a freedom in centric - Schuyler[38].
6. **The rationale of occlusal rehabilitation is to bring the mandible in terminal hinge relation (centric relation) and create a stable centric occlusion (maximal intercuspation). This is termed as organic occlusion[2,39,55].**

Terminology of jaw relations and occlusal positions by Arne Lauritzen[40]

Jaw relation

THR : Terminal Hinge Relation : This is a range of retruded mandibular opening and closing movements while the transverse hinge axis remains constant to both mandible and skull. THR is synonymous with centric relation position.

Occlusal relations

1.	OP	:	Occlusal Position
2.	IOP	:	Intercuspal Occlusal Position
3.	MIOP	:	Median Intercuspal Occlusal Position
4.	LIOP	:	Lateral Intercuspal Occlusal Position
5.	THIOP	:	Terminal Hinge Intercuspal Occlusal Position

Interpretation

1.	O.P	:	Any position of occlusion. From 2 to 32 teeth contacting each other.
2.	I.O.P	:	Position of maximum intercuspation of teeth with no reference to concomitant joint position. This position is generally referred as centric occlusion.
3.	M.I.O.P	:	When I.O.P occurs with both condyles anterior to their most retruded positions.
4.	L.I.O.P	:	When I.O.P. occurs as a pure lateral position, i.e., when only one condyle moves anteriorly (most unusual)
5.	T.H.I.O.P	:	When I.O.P. occurs while both

condyles are in their retruded positions (Mandible is in THR). The ideal "Centric Occlusion" It is centric occlusion in centric relation.

Character of occlusion in centric relation (Single centric or Dual centric occlusion)

Should centric occlusion contacts be established at a point or an area ? This question has lead to the development of two different concepts.

1. **Point centric or the gnathological centric occlusion** *(Lucia, Granger)*

   This happens when centric occlusion and centric relation coincide. It is a precise location of centric occlusion in centric relation. It is a maximum intercuspation seen or given in centric relation. The organic occlusion is an example of point centric. The Glossary of occlusal terms[7] recommends the term centric relation occlusion.

2. **Long centric (Panky, Mann), Freedom in centric, Area centric**
   When centric relation and centric occlusion do not coincide, a freedom is given to close the mandible either into centric relation or slightly anterior to it in centric occlusion with a smooth gliding, without effecting any change in vertical dimension of occlusion. Schuyler felt that absence of such eccentric freedom is an important contributory factor to trauma and loss of alveolar bone structure in natural and restorative dentition. He preferred the term freedom in centric to denote an occlusal pattern, which allows the patient to move forth and back from centric relation to centric occlusion, when both of them do not coincide.

   It is a freedom into centric and out of centric. Ramfjord refers this freedom in centric as play in centric. Beyron prefers the term area centric, since an area contact is obtained during function in centric. Patient can use ICP (intercuspal position, Syn. centric occlusion) for mastication and RCP (retruded contact position Syn. centric relation) for deglutition.

   Note : Long centric or freedom in centric does not exist in normal human occlusion but represents a principle to be followed in for patients who need occlusal reconstruction.

   Caution : Freedom in centric concepts does not in anyway compensate for incorrect recording of centric relation in a patient. It is not an adjustment for incorrect centric in restorations, but a planned laboratory procedure of obtaining a functional occlusal area or an occlusal field in restorations.

Basis of Long centric occlusion

This concept of dual centric is based on the findings that mastication occurs generally near centric occlusion and seldom in centric relation, while deglutition is near centric relation. Hence the need to establish freedom between these two positions to have a harmonious mastication as well as deglutition within the centric field. The masticatory musculature is thus able to select a favourable position without cusp interference, which occur during centric slide. The functional stamp cusps are free to move in the opposing fossa without interference. Freedom in centric is essentially a term used in occlusal rehabilitation. It is about 0.5 mm at the occlusal, most often is less than 0.3 mm[15].

Recording centric relation in edentulous subjects

In edentulous subjects, centric jaw relation is generally recorded by (a) wax closure method, (b) Functional chew-in technique, (c) Graphic method (Gysi gothic arch tracing technique). (d) Anterior deprogrammers

Wax closure method of recording centric relation with swallowing, phonetic and manual guidance is a quick and a simple procedure. The arrow point tracing method is a reliable and scientific procedure of recording the mandibular border movements in the horizontal plane and captures the mandible at its posterior reproducible border position.

Limitations of wax occlusal rim method to record centric relation

1. **Inconsistency of the record: Two centric records taken for the same patient may not always be identical. Patient co-operation and operator induced errors should be considered.**
2. Possibility of occlusal rims sliding over the other to any eccentric position either before, during or after sealing the occlusal rims in centric relation.
3. Tilting, leverage and displacement of record bases is very common and this may result in inaccurate centric record.
4. There is a tendency for the patient to bite and protrude the mandible. The term bite registration is therefore objectionable and obsolete.

Graphic method

Even though Balkwill,[41] an Englishman in 1866 illustrated the right and left intersection arcs of lateral movement, it was Hesse[42] from Germany, in 1897 introduced the graphic method of recording centric relation, which was later popularized by the Swiss Professor Gysi[13] in 1910 (Fig.5 & 6). It became known as Gysi gothic arch tracing since it resembled Gothic architecture characterised by high pointed arches. The Glossary of Prosthodontic terms recommends stylus tracing and central bearing tracing. Synon: arrow-point tracing, needle point tracing.

All movements in horizontal plane initiate from the apex of the gothic arch. The apex of tracing is a reproducible reference point which represents centric relation. Gothic arch tracing ensures that the centric record is made with minimal closing force equally distributed over the supporting tissues.

Intra oral Gothic arch tracing method[5]

In this method central bearing tracing stylus distributes occlusal force evenly to the supporting tissue areas during registration of centric relation. Except for the difficulty in visualizing the tracing, intraoral tracing method is preferred to the extraoral method. Solomon[43] claimed that in intraoral method the errors are likely to be less because the tracing is situated closer to the centers of movements in the temporomandibular joint in comparison to the flexible extra oral device which inscribes mandibular movement in a plate situated outside the mouth further away from centers of mandibular movement (Fig. 7). Further, the presence of extraoral tracer attachments prevents the lips from meeting each other and remain passive. According to him, the distinct advantage of intraoral tracing is the ability of the subject to perform mandibular movements with the lips in passive contact position.

Kapur and Yurkstas[44] found that intraoral and extraoral tracing procedure were more consistent as compared to the wax closure method. They also felt that minimal controlled pressure is truly not possible with wax records, while intraoral tracing method satisfied this requirement to a certain extent. Boucher[9] also recommended that centric relation should be made with minimal pressure to prevent displacement of the tissues supporting the dentures in order to achieve uniform simultaneous contact of the dentures. El Aramany[45] et al found needlepoint tracing to be a reliable method to record centric relation.

Indications of the graphic method

Graphic arch tracing method is preferred in good edentulous ridges with normal inter-arch relation. Arrow point recording is difficult in excessively resorbed and flabby ridges as it causes instability of the recording bases and contraindicates its use. Graphic method is also not indicated where there is inadequate inter-arch distance, as it is difficult to accommodate the tracing device without increasing the vertical dimension. A sharp arrow point cannot be recorded in persons with TMJ arthropathy. In these instances conventional wax closure method is the alternative choice.

Intraoral gothic arch tracing method is ideal in patients with habitual centric

Complete denture patients develop habitual centric relation due to faulty centric relation, or due to prolonged use of old denture with marked attrition which causes unconscious habitual positioning of the lower jaw. In these patients it is difficult to record centric relation with wax records as they tend to move the jaw to habitual centric jaw position, which is anterior to the actual centric position. Gothic arch method is indicated in these patients who have developed a habitual centric. With intra-oral gothic arch tracing method, the stylus eliminates occlusal contacts from occlusal rims and, therefore the habitual neuromuscular memory or engram is absent. The likelihood of sliding the lower jaw forward and laterally is hence eliminated. Moreover, in intra oral gothic arch method it is easier to secure the mandible in centric relation position against the tracing plate while obtaining centric record than with the wax closure method, where it is difficult to prevent sliding of occlusal rims.

Classification of arrow point tracing

Gerber[46] described six different types of gothic arch tracings. These are the classical pointed form, classical flat form, weak tracing, asymmetrical form, miniature form and tracing with vertical line beyond arrow point. In general the following types of gothic arches are noticed with intra oral tracing in dentulous and edentulous conditions (Fig. 9)

1. *Typical:* Seen as a well defined apex with a symmetrical left and right lateral component. The mean gothic arch angle is about 120 degrees. It reflects a healthy TMJ without interferences in condylar path and a balanced muscle guidance. The symmetrical form indicates an undistributed movement of the condyle in fossa and distal slope of eminence with symmetrically balanced muscle guidance.
2. *Flat form:* It is similar to typical arrow point except that it has a more obtuse left and right lateral tracings. This type of arrow point signifies a marked lateral movement of condyle in the fossa. The gothic arch angle is more than 120^0.
3. *Asymmetrical form:* (i) The left and right lateral tracings meet in an arrow point, however their inclination to the protrusive path is not symmetrical. (ii) One of the lateral tracing is shorter. This form of tracing indicates an inhibition of the forward movement, either in the left or right joint.
4. *Apex absent / round form:* Instead of a sharp arrow point , the tracing is rather round . It shows a weak retrusive movement. Tracing should be repeated till a definite arrow point is obtained. Patient training is necessary.
5. *Miniature arrow point:* Similar to the typical arrow point, however the extension of tracing is very limited. This can be due to restricted mandibular movements, improper seating of record bases, and painfully fitting record bases during registration. It is also an indication of a long period of edentulousness with an inhibition in condylar movements.
6. *Double arrow point :* It is a record of habitual and retruded centric relation. Allow patient training and repeat till a single gothic arch is obtained. It is also seen when vertical dimension is altered during registration.
7. *Dorsally extended arrow point :* The protrusive path extends beyond the apex of the gothic arch . This signifies a forced strained retrusive movement of the lower jaw either by the patient or

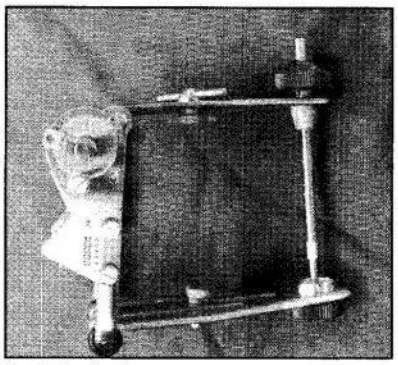


Fig. 1a : Gerber's Articulator

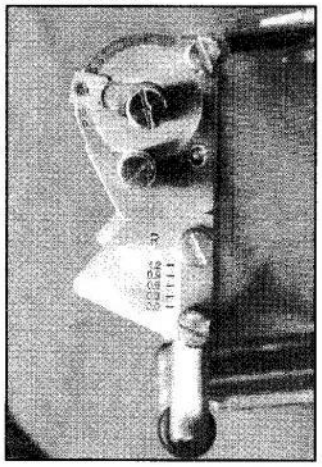


Fig. 1b : Vernier scale for vertical adjustment of the articulator to accommodate joint compression and distraction

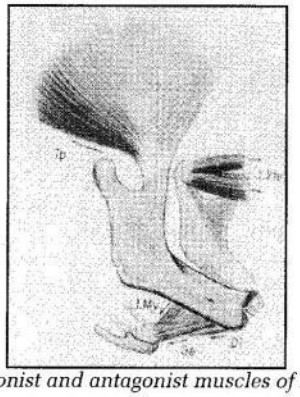


Fig. 2 : Protagonist and antagonist muscles of mandibular retrusion

Fig. 3 : Internal pterygoid and masseter close the mandible in power centric

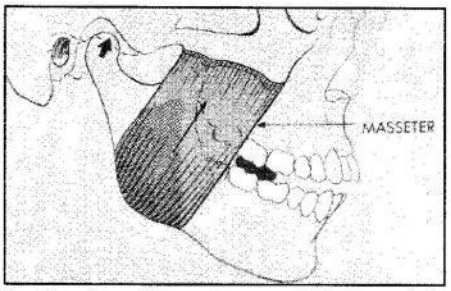


Fig. 4 : The direction of masseter muscle favours A-S positioning of condyles during centric closures

Fig. 5 : Professor Alfred Gysi of Zurich

Fig. 6 : Gysi himself demonstrating sagittal condylar inclination and gothic arch

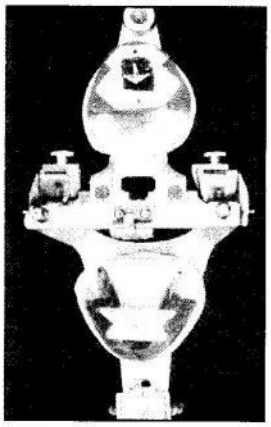
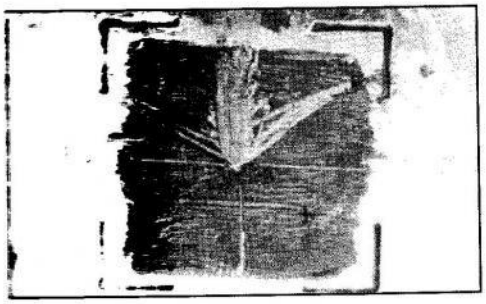
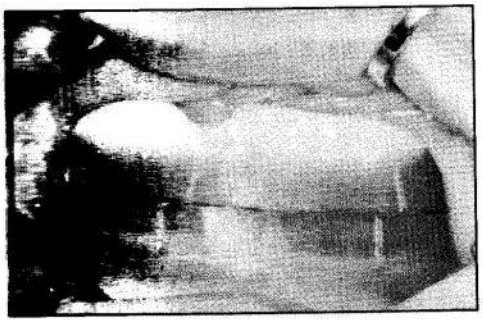


Fig. 7a : An ideal gothic arch tracing obtained with intra oral tracers



: An ideal gothic arch tracing obtained with intra oral trac-



: Sliding of lower occlusal rim commonly noticed in ha-

by the operator. During registration procedure lower jaw is either forcibly retruded by patient. (active retrusion) or forcibly retruded manually by the operator (passive retrusion)[47]. It is also sometimes an artifact caused by the forward displacement of upper occulsal rim or backward dislodgement of lower occlusal rim while removing them from the mouth. The arrow point tracing is correct, but at a particular stage there was sliding of upper occlusal rim forward and lower displacing backward.

It can also occur when the head of the patient is tilted too far posteriorly. The registration should be repeated after correct head positioning. Gerber[26] felt that occasionally the distal extension is correct, but the tracing was obtained with the mandible in protruded position.

8. *Interrupted gothic arch :* Break or loss of continuity of lateral incisal path of gothic arch . This happens due to posterior interference at the heels of occlusal rims during lateral movements. Check for posterior clearance before recording.
9. *Atypical form:* Protrusive component does not meet at apex but on one of the lateral path . This may happen in dentulous because of a faulty muscular pattern due to parafunctional habits like bruxism. It is also seen in very old edentulous patients, who are using complete dentures with incorrect centric relation.

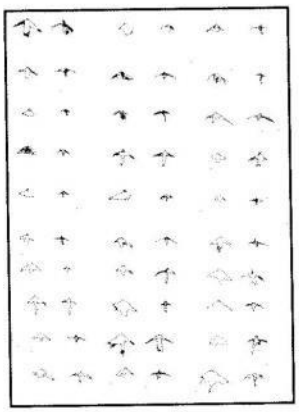


Fig. 9 : *Transposition of various types of gothic arch tracings in dentate and edentulous subjects. A forced or strained retruded centric is seen as a distal extension from the apex of gothic arch. Envelope of motion is traced in each gothic arch*

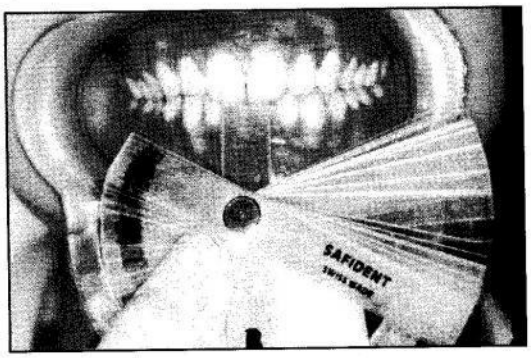


Fig. 10 : *Leaf gauge is placed between anterior teeth to deprogram and tripodize the mandible*

How to guide the mandible to centric relation in a dentulous situation

A. OPERATOR GUIDED METHODS – MANUAL GUIDANCE

"Bilateral relaxation of external pterygoid muscle is essential to obtain true centric"

Manual guidance is the use of external guidance by the operator to assist the subjects musculature to seat the condyles and mandible in centric position. The limitation with manual guidance is the difficulty in relaxing the antagonist muscles, which protrude the jaw.

1. *Chin point guidance - Guichet[48] (1970)*
   Thumb and forefinger – Positions the condyle in RUM position
2. *Bimanual method – Peter Dawson[15] (1974)*
   Guides the mandible in most superior anterior position
3. *Three finger method – Peter Thomas[49] (1980)*
   Thumb, forefinger, middle finger – Positions condyle in anterior superior position

B. ANTERIOR DEPROGRAMMER

An anterior deprogrammer provides anterior stop to eliminate posterior tooth contacts during closure of jaws. thereby eliminating proprioceptive influence from the

teeth. This allows subjects neuromusculature to seat the condyles in its centric position without the influence of periodontal proprioception or engram.

1. *Leaf gauge principle – Long[50] (1973), Williamson[34] (1980)*
   Leaf gauge guides the mandible to obtain optimum superior anterior braced position of condyles against the disc. McHorris[28] felt that leaf gauge helps to tripodize the mandible and brace the condyles in AS position against the posterior slope of articular eminence. Long found that leaf gauge is a reliable method for consistently placing the condyles in centric position (Fig. 10).
2. *Anterior Jig - Lucia[16] (1983)*
   Jig is a covering on the upper incisors fabricated in acrylic resin having an occlusal platform against which the lower anterior teeth will close. It acts as a third leg of tripod, the other two legs being the condyles. This leg acts as an anterior resistance and stops mandibular closure, without any deviation. Jig is a useful tool for obtaining centric interocclusal records free from deflective contacts and therefore eliminates the influence of engrams during centric registration.

Types of anterior deprogramming devices

The concept of anterior deprogramming was introduced by Stuart when he placed a wooden tongue blade between upper and lower teeth while closing the jaws. Hart Long[50] gave a scientific approach to it by inventing the leaf gauge. Lucia[16] obtained a similar effect with an anterior jig. Woelfel[51] introduced his OSU leaf wafer technique to obtain centric inter-occlusal record

Leaf gauge consists of fifty, 0.1 mm thick polyester/ vinyl leaves of 10 mm X 50 mm bound together at one end to form a gauge. X number of leaves are placed between anterior teeth to obtain posterior disclusion and centric seating of the condyles. Leaf gauge eliminates the potential error in manipulating the patients jaw into centric relation by permitting patients own neuromuscular to seat the condyles correctly (Hufmann[52], Mcmillen[53])

Uses of leaf gauge

1. Helps to deprogam the muscles and tripodizes the mandible for obtaining centric interocclusal record by assisting the patient's neuromusculature to seat the condyles in anterior superior position[28,50-54].
2. Useful to detect centric prematurities in dentulous subjects[50,54].
3. Useful in TMJ dysfunction to eliminate muscle memory or engram. It helps to identify occlusal prematurities and also to indicate the optimum vertical height for fabricating occlusal splints[54].

SUMMARY

Mandibular and condylar centric positions are represented from a static and functional perspective. Wax closure and gothic arch tracing are essentially a static closed mouth maxillo-mandibular position. Mandible is seldom in this static centric relation position except during deglutition.

Condylar centric which is a seated position of condyle disc complex against eminentia, is load bearing up to $5^0 - 10^0$ of hinge opening when food bolus is present between teeth. At this time, the jaws are separated and therefore mandible is not in its centric position. When mandibular centric position is reached, the cusps occlude in centric occlusion. Mastication is then already completed. Condylar centric loading primarily occurs when food bolus is present between teeth and not after occlusion is reached in the mandibular centric position. Mandibular centric position is used mostly for deglutition.

Occlusion in centric relation is articulator related. In vivo, this position is used for deglutition and seldom for mastication. Basically mandibular centric position is a closed mouth relation, as opposed to condylar centric position which is a closed mouth and an open mouth relation.

In complete denture construction centric jaw relation is recorded with an expectation that the condyles are also in centric position. From a review of the several definitions on centric relation, it is not apparent whether the condylar centric dictates the mandibular centric position or vice versa. Nevertheless, a harmony between both the positions is indispensable in Prosthodontic practice.

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A comparative evaluation of custom tray designs on dimensional accuracy of elastic impression materials - *An in-vitro study*

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ABSTRACT

A fixed restoration should have excellent esthetic values, good harmonious occlusion, contact points and adequate fit. Fabrication of custom tray for impression with resulting stone cast with minimum distortion is the logical step in achieving the objectives. It is mandatory that resulting stone cast should show minimum distortion. The various elastic impression materials and custom trays play a vital role in this phase. The study was planned to evaluate the vertical, horizontal and cross arch distortion of elastic impression materials and effect of custom trays over it. All the elastic impression materials and custom trays tested in this study showed acceptable accuracy with minimum distortion of resulting stone cast.

INTRODUCTION

The accuracy and dimensional stability of the various impression materials are vital for clinical success of restorative dental procedures. The life like restoration with excellent esthetic values, immense functional utility and psychological comfort of the patient is critical for successful fixed restoration.

Impression play a vital role in success of fixed restorations. Elastomers are widely used as impression materials. The ability to reproduce minute details and undercuts due to elastic recovery is an important virtue. Many materials are used for this job. Though the irreversible hydrocolloids have definite limitations due to their properties of imbibition and syneresis and difficulty in storage, these are also widely used in our country. A well fitting tray plays important role in optimising the properties of elastic impression materials.

Several investigators have studied the accuracy and dimensional stability of elastic impression materials.

Hosoda H, Fusayma[5] stated that dimensional accuracy of impression was one of the most important factor in the production of indirect working casts for inlays and other fixed denture prostheses.

Mitchell JV, Damele JJ[6] reported the effect of different tray designs on the accuracy of impressions made in polysulphide and silicone rubbers.

The study was planned to evaluate the distortion of four commercially available elastic impression materials in vertical, horizontal and cross arch plane and the effect of custom tray designs over it.

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The aims and objectives of the study were :

1. To investigate the restrictive influence of tray designs upon distortion of four types of commerically available elastic impression materials.
2. To determine the vertical, horizontal, and cross arch changes of the stone cast produced from four elastic impression materials.

MATERIALS AND METHODS

For this study a standard metallic brass model of upper jaw was made to serve as a master model simulating a three unit fixed partial denture serving premolar and molar as abutments with complete crown preparation reference lines were inscribed on buccal and occlusal surfaces of abutment teeth.

Three types of acrylic resin trays were prepared perforated (P), rimlock (R) and undercut trays (U). Master model was used for preparing the trays. Wax spacer of recommended thickness for the particular impression material was tested. The elastic impression materials tested include Polyether A (Impregum), Addition silicone B (Accurate mono) and two types of irreversible hydrocolloids as Hydrogum C (Zhermack) and Dentalgin D (manufactured by Dentfills). The elastic impression materials were manipulated according to manufacturer's instructions and placed in various trays, and impressions were made of brass master model. For each impression material 5 impressions were made in each design of custom tray. Total 60 impressions were made and 60 stone cast were poured in class III dental stone (ultrastone) and dried for one week in order to obtain maximum dry hardness and strength. The inscribed reference points on the buccal and occlusal surfaces were easily recognized in all impressions and stone cast.

The cast were numbered as follows -

For polyether (A) rubber impression material -

Perforated tray (P) rubber AP_1 to AP_5
Rimlock tray (R) rubber AR_1 to AR_5
Undercut tray (U) rubber AU_1 to AU_5

Similar way the cast were numbered for other impression materials. Then measurements were made on each stone cast by using digital electronic caliper in vertical, horizontal and in cross arch plane. Statistically the average distortion and standard deviation were calculated for each series.

RESULTS

Table 1. 2. 3 shows mean distortion of impression materials in custom trays in vertical, horizontal and cross arch plane.

The result showed that for addition silicone material the undercut design of custom tray exhibited minimal distortion in vertical, horizontal and in cross arch plane (Table 1. 2. 3 Graph I, II, III).

For polyether, distortion was minimal in rimlock tray in all three planes and for Hydrogum and Dentalgin irreversible hydrocolloid impression materials distortion was minimal in perforated tray. (Table 1, 2, 3 and Graph I, II, III)

TABLE I

Mean distortion of impression materials in custom trays in vertical plane

	Addition Silicon Mean (mm)	Polyether Mean (mm)	Hydrogum Mean (mm)	Dentalgin Mean (mm)
Standard value	7.98	7.98	7.98	7.98
Perforated tray	8.09	7.99	8.00*	8.14
Rimlock tray	7.93	7.97*	8.07	8.18
Undercut tray	7.99*	8.12	8.03	8.08*

*Mean value is close to the standard value.

TABLE II

Mean distortion of impression materials in custom trays in horizontal plane

	Addition Silicon Mean (mm)	Polyether Mean (mm)	Hydrogum Mean (mm)	Dentalgin Mean (mm)
Standard value	16.49	16.49	16.49	16.49
Perforated tray	16.40	16.34	16.52*	16.47*
Rimlock tray	16.34	16.49*	16.60	16.42
Undercut tray	16.54*	16.46	16.46	16.45

*Mean value is close to the standard value.

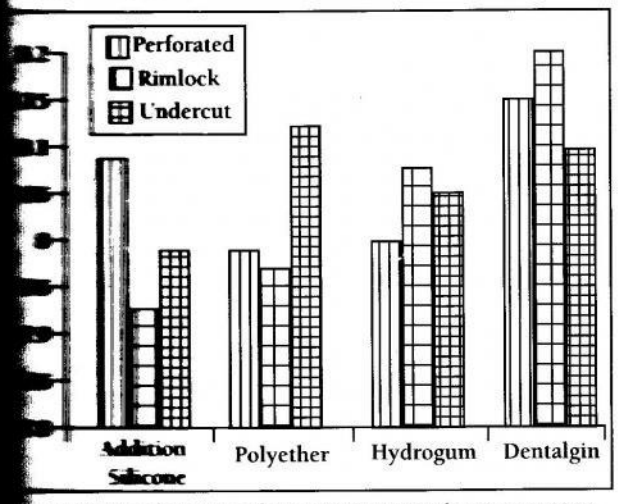

Fig. 1 : Vertical distortion of impression materials in custom tray

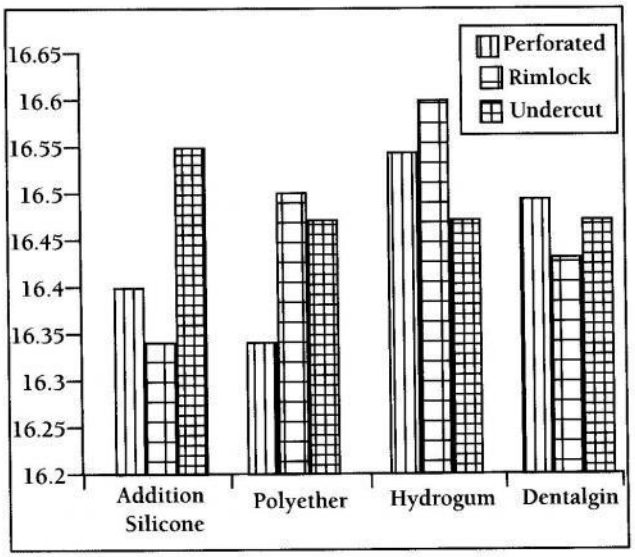

Fig. 2 : Horizontal distortion of impression materials in custom tray

TABLE III

Mean distortion of impression materials in custom trays in crossarch plane

	Addition Silicon Mean (mm)	Polyether Mean (mm)	Hydrogum Mean (mm)	Dentalgin Mean (mm)
Standard value	41.24	41.24	41.24	41.24
Perforated tray	40.94	40.81	41.27*	41.22*
Rimlock tray	41.07	41.11*	41.11	40.90
Undercut tray	41.13*	41.03	40.95	41.11

*Mean value is close to the standard value.

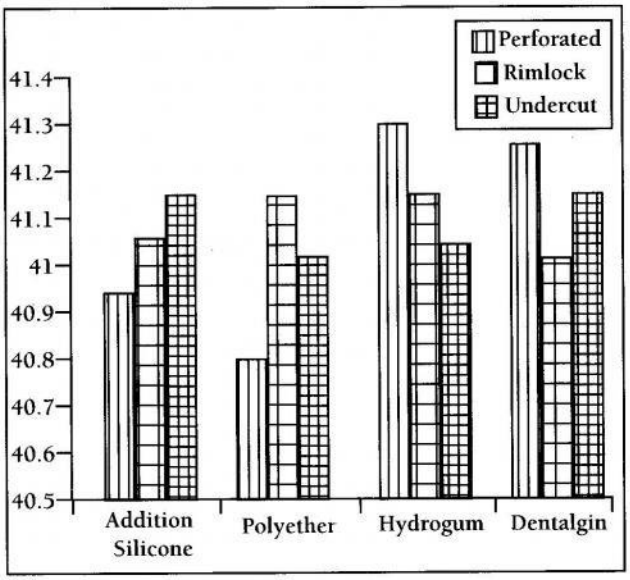

Fig. 3 : Crossarch distortion of impression materials in custom tray

DISCUSSION

The four elastic impression materials and three custom tray designs were studied. All the stone casts showed vertical, horizontal and cross arch distortion when compared with master model from the above results-irreversible hydrocolloid showed minimum distortion in perforated tray. This may be due to -

1. Mechanical adhesion increases the retention and decreases the distortion.
2. Stresses within this bulky material might be released as the material flows through the perforations.

Polyether impression material showed minimal distortion in rimlock tray, this may be due to the fact that the material flow is more than alginate, while making the impression required compression is developed equally all over the tissues and excess material flows out showing minimum distortion.

For addition silicone material, undercut tray design showed minimal distortion. This may be due to material flow which is more towards the undercut area, thus the compressive stresses required are minimum and the stresses are released slowly through the excess material minimizing distortion.

From the above results one would assume that the unrestricted shrinkage of an impression would produce undersized cast. In this study, the inaccuracies observed were the result of oversized and undersized artificial stone cast. According to Mitchall JV and Damele JJ[6], "The distortion produced by shrinkage of elastic impression materials not restricted by the form of tray was of minimal proportion, shrinkage of the impression material towards the attachment of tray was a major contributor to distortion."

Previous studies[1-7] reported under sirable dimensional changes and inaccuracies of the stone cast resulting from excessive and uneven thickness of the elastic impression materials when stock trays were employed, hence several reports emphasizes the importance of custom made trays.

SUMMARY

Three types of custom tray designs and four commercially available elastic impression materials were evaluated. All the elastic impression materials and custom trays tested in this study appear to be capable of obtaining acceptable accuracy and showed minimum distortion of resulting stone cast so for that it is recommended to use undercut trays for addition silicone, rimlock trays for polyether and perforated trays for irreversible hydrocolloid impression materials whenever possible.

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Abstract

Cervical dentin hypersensitivity : The air indexing method

Numerous patients experience acute or chronic sensitivity & pain in the cervical regions of teeth. This appears to result from changes in osmotic pressure within open dentinal tubules. Methodology for assessing cervical dentin hypersensitivity of individual teeth is based on pulpal response to cold air, osmotic, tactile or electrical stimulation.

The purpose of this article is to introduce an objective method for quantifying cervical dentin hypersensitivity. Air emission from a standard air-water syringe with a fluid control block are directed towards the crevices of teeth at a 45 degrees angle to the long axis of test teeth from a distance of 0.5 cm for 0.5-1.0 sec. An air indexing method has been developed to quantify threshold patient response values for individual teeth to this defined air stimulus. The air indexing method, using the fluid control block offers the clinician objective information to compare cervical dentin hypersensitivity before & after treatment for this common, painful condition.

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