

ORIGINAL ARTICLE

Comparative evaluation of changes in positions of working models mounted on SAM-II articulators using three different interocclusal record materials –An in vivo study

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ABSTRACT

Statement of Problem: The condylar position can vary depending on several factors. One factor could be the type of interocclusal record material used to transfer the maxillomandibular relations on to the articulator. The flow/viscosity of the record material can influence the recording of the retruded condylar position. **Purpose:** To determine the position and to quantify the change in the position of the condyles in 3 directions, as well as the changes in occlusal surface contacts from recorded condyle position to intercuspal position, when different interocclusal record materials are used. **Material and method:** The study comprised of 11 dentulous patients. Accurate stone casts were made from hydrocolloid impression material. Face-bow transfer was done using SAM face-bow. This maxillary cast was then mounted on the SAM-2 articulator. The Mandibular cast was oriented to the maxillary cast by hand held articulation. This was considered as the Control group. Three different inter-occlusal recording materials used for the study were-Alu wax, Zinc oxide eugenol and Poly ether. To maintain the same thickness between the records for each patient an acrylic jig was placed between the anterior teeth during the recording procedure. These records were placed between the Maxillary and Mandibular casts on the SAM 2 articulator and retruded condylar position readings were been recorded. Then the upper member of the SAM 2 articulator was removed and repositioned by Mandibular position indicator. The 3D readings were tabulated to measure the displacements at the condyles. Maxillary casts of all 3 groups were transferred to the Mandibular position indicator and co-ordinates in X, Y, and Z as well the Delta L and Delta H were recorded. The data obtained from the different inter occlusal records were compared with that of readings of Hand held articulation. The MPI data, that is Delta Y, Delta X and Delta Z were evaluated and analyzed. The relative change in the position in different axis were subjected to statistical analysis using one way analysis of variance and Tukey's test. **Result:** The overall comparison of the changes in the positions of the condyles in different axes among the different groups used in the study was proved to be statistically insignificant. Similarly, comparison of the changes in the positions of the occlusal surfaces represented by incisal pin and guidance table among the different groups used in the study was also proved to be statistically insignificant. **Conclusion:** No significant change in the position of the condyles as well as incisal pin and guidance table relationship were found among the mounted models as well as in occlusal surface contacts from recorded condyle position to intercuspal position.

Key words: Retruded condylar position, interocclusal records, maximum intercuspal position.

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INTRODUCTION

Removable denture and fixed partial dentures are indirectly made prostheses which have to be made in harmony with the existing occlusion so that the prosthesis would be placed in the mouth without doing any occlusal adjustments. Interocclusal records have become most popular method of transfer of maxillomandibular relations from mouth to articulator. However to achieve this goal all the required procedures in fabricating the prostheses, as well as selecting an accurate and a dimensionally stable interocclusal record material is important.

The causes of occlusal discrepancies, attributable to the interocclusal record can be divided into three categories. One cause is related to the biologic characteristics of the stomatognathic system, second is attributed to iatrogenic errors and third cause is associated

with the properties of the interocclusal recording material and an inappropriate relationship of the mandibular cast to the maxillary cast on the articulator^{1,2}. Though the techniques for recording jaw relation and their transfer on to the articulator are well established procedures, dimensional changes and rigidity of the inter-occlusal jaw relation recording materials might result in variation in the relationship of the working models on the articulator.

Some of the routinely used interocclusal record materials are the waxes, impression plaster, zinc oxide eugenol paste, impression compound, acrylic resins and elastomers. There are many studies conducted illustrating the errors of commonly used interocclusal record materials³⁻⁵.

There are many studies pertaining to the change in dimension of restorations related to various materials and techniques used in fixed prosthesis, there is little information regarding variation in the position of these working models in 3 planes, on the articulator. A Mandibular position indicator which is used for recording the positional errors of condyles in all 3 planes may be useful in determining the magnitude of such errors, caused by rigidity and dimensional changes of the interocclusal record materials. The flexibility and the dimensional errors in different interocclusal record materials can cause variation in the cast to be mounted. Therefore this study is planned to quantify the positional errors in mounting using Mandibular position indicator.

AIM AND OBJECTIVES

AIM: This study aims at comparing and quantifying the changes in the position of the working models mounted on SAM-2 articulator using hand held articulation, and articulation using three different interocclusal record materials. The interocclusal records used are nonrigid, thermoplastic and rigid in nature.

OBJECTIVES OF THE STUDY: Assuming all the procedures, standardize the same for all 3 materials. The change in the position of the condyles can be attributed to the jaw relation recording materials, which will be recorded in the Mandibular position indicator. In order to eliminate the variables like muscle induced avoidance mechanism, joint resiliency and tooth guided movements of the mandible, anterior Acrylic jig will be used. This jig made in Acrylic would result in same.

The objective of the study being:

1. To determine position and to quantify the change in the position of incisal pin and guidance table relationship representing the changes in occlusal surface contacts from recorded condyle position to intercuspal position. (denoted by Delta H and Delta L respectively.)
2. To quantify and compare the change in the position of the condyles in 3 directions (X, Y, and Z axes), upon articulation of the models by :
 - a) Hand articulation
 - b) Interocclusal records made

with:-

- i) Alu wax
- ii) Zinc oxide eugenol bite registration paste
- iii) Polyether bite registration paste.

Methodology

A group of screened dentate population was informed about the purpose and procedure involved in the study. After seeking their consent to participate in the study, a total of 64 dental students and young technicians from SDM Dental College and Hospital, Dharwad were screened and 11 dentulous subjects were selected. These were the test subjects for the study. The Criteria used for Case Selection were;

- 1) Normal complete dentition
- 2) Angle's class one occlusion with no crowding or bimaxillary proclination.

Exclusion Criteria included: Dentulous persons having visible tooth wear, deviating/ deflecting contacts, TMJ problems, cross bite, erupting third molars, gross restorations, loss of contact points etc.

The armamentarium used for this included the SAM-2 articulator, the SAM anatomic face bow, and the mandibular position indicator. The procedure was mostly, as described by *Slavice*⁶ and instructions given in SAM, MPI 300 Mandibular position indicator manual⁷. The details of the selection of test subjects and procedure followed are as described below.

Impression making:

Stone casts were derived from impressions made of alginate on 11 dentulous patients. The mandibular cast is duplicated 4 times. This is done to mount the maxillary cast with the mandibular cast using 3 different interocclusal record materials and one in hand held articulation.

Face bow record:

The maxillary cast is transferred to the articulator with the face bow. Then the maxillary cast is mounted with plaster with the help of SAM mounting jig.

In this study an anterior acrylic jig was used to record the retruded condyle position to avoid deviating interferences caused from teeth.

Hand held articulation:

Once the maxillary cast is mounted on SAM-2 articulator, the incisal pin is set to 0. The Bennett angle is set at 5° and the condylar housing is set at 30°. The mandibular cast is hand articulated with the maxillary cast and the mounting is completed.

Fabrication of Customized acrylic jig:

An acrylic jig was used to record the retruded condylar position. This jig prevented any of the posterior teeth from coming in contact when the centric relation was recorded. Further, the jig was adjusted in such a way that prevented the first point of posterior tooth contact. The jig maintained a uniform space in the posterior segment whenever the bite registration was made.

Articulation using interocclusal records:

As mentioned earlier, 4 mandibular casts were duplicated. Each of the interocclusal record materials were seated on the mandibular cast and the mandibular cast along with the jaw relation recording material was oriented to the previously mounted maxillary cast. The maxillary and the mandibular casts along with interocclusal record materials were held firmly with rubber bands and the mounting procedure was carried on. (picture-1a,1b,1c)

Thus, mountings of upper and lower casts of 11 different subjects were done on SAM articulator using 3 different interocclusal record materials and one in Hand held articulation.

The hinge axes of the articulator's condylar spheres duplicate the hinge axes of osseous condyles. When the mandibular cast is mounted in retruded condylar position

(RCP), the joint dominated position is fixed by these hinge axes of the articulator and the incisal pin position is set to the point of initial contact.

Assessment of the condylar position:

Recording incisal pin and incisal table readings in RCP:

The incisal pin assembly is placed on to the upper member of the articulator. An adhesive grid paper is attached to the incisal table on the lower member. The upper member is lowered in retruded condyle position until initial tooth contact.(picture 2a) The incisal pin is lowered until it touches the incisal table and is locked in this position.

The articulator is now reproducing the hinge axis of each condyle in the unstrained bite position at the point of first contact of the teeth. A piece of red articulating paper is placed on the incisal table under the incisal pin to mark the pin position with a light tap (picture 2b). The height of the incisal pin is recorded in plus or minus millimeters. The 3 co-ordinates of the plane of the mandible (2 hinge axes positions and incisal pin position)-uninfluenced by teeth, are now fixed in space on the articulator and recorded.

Transferring the maxillary cast on the mandibular position indicator:

The MPI and the upper cast of the SAM-2 articulator are identical, except that the interference of the condylar housing of the articulator is eliminated in the MPI. These housings are replaced with condylar post. This enables complete freedom of the maxillary cast when the incisal pin is retracted. The casts can then be occluded to a position of maximum intercuspation or tooth dominated position called as intercuspal position (ICP), (picture 2c) for comparison to the joint dominated position, also called retruded condylar position (RCP). The MPI is designed to accept the maxillary cast in the same co-ordinate system it had on the articulator and the incisal pins of the articulator and the MPI are the same. The upper cast, mounting plaster and ring are transferred to the MPI. The mandibular cast remains on the lower member of the articulator. The MPI is placed above it and the mounted maxillary cast is interdigitated with it. The system now gives measurements and comparisons of the co-ordinate systems.

Adhesive grids with X and Z co-ordinates are placed on the black lateral sliding blocks of the MPI. The dial gauge is adjusted to zero. The MPI is moved into position between the condylar balls of the articulator: the blocks are medially positioned without allowing the hinge axes needles the perforate the grid paper. The maxillary cast is interdigitated with the mandibular cast in intercuspal position (picture 3a). This position is maintained during the remaining procedures.

Recording the incisal pin and incisal table readings in ICP :

The incisal pin of the MPI is lowered to the incisal table and locked. A piece of blue articulating paper is placed between the incisal pin and the incisal table, and a mark is made on the incisal grid by taping the pin. The incisal pin's vertical value is read and recorded. The anterior posterior distance between the blue ICP dot and the RCP dot is measured and recorded as delta L value (picture 3b).

Recording the condylar post reading:

Black articulating paper is placed next to the sphere of one condylar post, and the black sliding cube with its grid paper is taped against it, marking the hinge axis position on the grid paper (picture 4a). This procedure is repeated on the other side also.

Recording the dial gauge reading:

The pin from the dial gauge is placed into its slot in the black cube. The cube, with the grid paper still attached, is slid over the condylar ball without the articulating paper. The dial gauge is read (picture 4b,4c). Recording on the Y axis going to the right is a negative value indicating for the medial movement of the condyle. The left side is measured and identified with positive value: indicating for lateral movement of the condyle. The smaller within the gauge gives the millimeter amounts and direction of movement. The dial gauge reading is recorded as plus or minus delta Y in tenths of millimeter on the diagnostic sheet.

Transferring the hinge axis:

The MPI is removed from the articulator. The black cubes are pushed medially so that the hinge axis needle will perforate the grid paper to transfer the original hinge axis position. If the hinge axis perforation and the black dot coincide, the area is circled with a pen. It is important not to perforate the grid paper before this time, so that distortions do not occur when marking the articulating paper (picture 5).

Transferring the grid paper to diagnostic sheet:

The grid papers are removed from the cubes and placed on to the diagnostic sheet. The X, Y measurements are read off and recorded. A black dot above the perforation is given a (+) value to reflect a compression situation: if it goes below the perforation, it is given a (-) value indicating a distraction.

If it is anterior, it is (+), if it is posterior it is (-). To evaluate the statistical significance of the relative changes in different axes, when different interocclusal recording materials are used, the mean and the standard deviation of respective values -Delta H, Delta L, Delta Y, both right and left Delta X and Delta Z were subjected to one way analysis of variance and Turkey's test.

RESULTS

Evaluating MPI data:

TABLE-IV-a: MPI indicating the variation in change in the position of the mandibular cast oriented to the maxillary cast for different groups in all the 3 different axes

Serial number	ΔH	ΔL	ΔY	ΔX	L ΔX	R ΔZ	L ΔZ
1	-1mm	-0.75mm	0.3mm	-1mm	1mm	-3mm	-2mm
2	-2.5mm	-0.5mm	0.45mm	1mm	- 1mm	-1.25mm	1mm
3	-1mm	0.5mm	-2.1mm	1mm	0.5mm	-1.25mm	-1.25mm
4	-2mm	1mm	0.75mm	1mm	0.25mm	-2mm	-1.5mm
5	-0.5mm	-1mm	-0.6mm	1.2mm	-1mm	-1mm	-1mm
6	0.75mm	-1mm	0.75mm	1mm	-1mm	-1mm	-1mm
7	-1mm	-1mm	0.4mm	-1mm	1mm	-2mm	-2mm
8	-2.5mm	-1.5mm	1mm	1mm	-1mm	-1.25mm	1mm
9	-1mm	-1mm	-2.2mm	1mm	0.5mm	-1mm	-1.25mm
10	-2mm	1mm	0.75mm	1mm	-0.25mm	-0.5mm	-1mm
11	-0.5mm	-1mm	-0.75mm	1.5mm	-1mm	-1mm	-1.2mm

It is evident from the readings that along ΔH the A +ve indicates vertical difference in ICP and RCP is increased and a - Value indicates vertical difference in ICP and RCP is decreased. For Delta L: A + value means that the position of condyle in ICP is anterior RCP.

A - Value means that the position of the condyle in ICP is posterior RCP.

For Delta Y: A + value means condyle is deviated to the left, indicating lateral movement of the condyle.

A - Value means condyle is deviated to the right, indicating medial movement of the condyle

For Delta X: A +Value means the ICP position of the condyle is anterior to the RCP.

A - Value means the ICP position of the condyle is posterior to the RCP.

For Delta Z: A +Value means the ICP position of the condyle is inferior to RCP, indicating inferior displacement of the condyles.

A - Value means the ICP position of the condyle is superior to RCP, indicating superior displacement of the condyles.

Table-I: Statistical comparison of difference of MPI values between different groups(Hand articulated group, groups articulated with Aluwax, groups articulated with ZOE bite registration paste, groups articulated with Polyether bite registration paste) by paired T test. (n=11 in each case)

Source of difference	Difference in values	DF	T	P	REMARK
ΔH values of CONTROL ALUWAX	MEAN 0.336	10	1.18	0.2636	NS
	SD 0.284				
ΔH values of CONTROL ZOE	MEAN 0.336	10	1.18	0.2636	NS
	SD 0.284				
ΔH values of CONTROL POLYETHER	MEAN 0.000	10	0.00	1.00	NS
	SD 0.2050				
ΔL values of CONTROL ALUWAX	MEAN -1.368	10	-3.11	0.011	NS
	SD 0.439				
ΔL values of CONTROL ZOE	MEAN -0.800	10	-1.63	0.133	NS
	SD 0.439				
ΔL values of CONTROL POLYETHER	MEAN -0.431	10	-0.82	0.428	NS
	SD 0.523				

In all the cases when paired T-test was conducted, no significant difference was found between the different groups.

Table-II-a: Statistical intercomparison (by one way ANOVA) of the hand articulated groups, the groups mounted using aluwax, ZOE, Polyether bite registration paste along Delta Y:

SOURCE	D.F	S.S	MS	F	P	REMARK
BETWEEN	3	1.096	0.365	0.25	0.862	NS
WITHIN	40	59.03	1.47		-	
TOTAL	43	60.13	-	-	-	-

Result shows no statistical significance at 1% level ($p < 0.01$) and at 5% level of significance. From the results of the above table the 4 groups show no significant difference along the difference in transverse direction that is right or left movements of the condyles.

TUKEY PAIRWISE COMPARISONS OF MEAN

ΔY IN GROUPS	MEAN	HOMOGENEOUS GROUPS
CONTROL	-0.113	I
ALUWAX	0.118	I
ZOE-PASTE	0.2364	I
POLYETHER	0.300	1

There are no significant pairwise differences among the means of the groups along Y axes

Table-II-b: Statistical comparison (by one way ANOVA) of the Hand articulated groups, the groups mounted using Aluwax, ZOE, Polyether bite registration paste along Delta X (left side condyle):

SOURCE	D.F	S.S	MS	F	P	REMARK
BETWEEN	3	7.602	2.534	3.08	0.038	NS
WITHIN	40	32.95	0.823		-	
TOTAL	43	40.56	-	-	-	-

Result shows no statistical significance at 1% level ($p < 0.01$) and at 5% level of significance. From the results of the above table the 4 groups show no significant difference along horizontal direction pertaining to the left condyles of the subjects used in the study.

TUKEY PAIRWISE COMPARISONS OF MEAN

ΔX IN GROUPS (left side condyle)	MEAN	HOMOGENEOUS GROUPS
CONTROL	-0.1881	I
ALUWAX	0.795	I
ZOE-PASTE	0.772	I
POLYETHER	0.159	1

There are no significant pairwise differences among the means of the groups along X axes-left condyle

Table-II-c: Statistical comparison (by one way ANOVA) of the Hand articulated group, the groups mounted using Aluwax, ZOE, Polyether bite registration paste along Delta Z (left side condyle):

SOURCE	D.F	S.S	MS	F	P	REMARK
BETWEEN	3	0.688	0.229	0.13	0.943	NS
WITHIN	40	72.02	1.800		-	
TOTAL	43	72.70	-	-	-	-

Result shows no statistical significance at 1% level ($p < 0.01$) and at 5% level of significance. From the results of the above table the 4 groups show no significant difference along vertical direction pertaining to the left condyles of the subjects used in the study.

TUKEY PAIRWISE COMPARISONS OF MEAN

ΔZ IN GROUPS (left side condyle)	MEAN	HOMOGENEOUS GROUPS
CONTROL	-0.927	I
ALUWAX	-1.00	I
ZOE-PASTE	-1.09	I
POLYETHER	-0.750	I

There are no significant pairwise differences among the means of the groups along Z axes-left condyle.

Table-II-d: Statistical comparison (by one way ANOVA) of the Hand articulated group, the groups mounted using Aluwax, ZOE, Polyether bite registration paste along Delta X (right side condyle):

SOURCE	D.F	S.S	MS	F	P	REMARK
BETWEEN	3	1.928	0.642	0.87	0.463	NS
WITHIN	40	29.46	0.736		-	
TOTAL	43	31.39	-	-	-	-

Result shows no statistical significance at 1% level ($p < 0.01$) and at 5% level of significance. From the results of the above table the 4 groups show no significant difference along horizontal direction pertaining to the right condyles of the subjects used in the study

TUKEY PAIRWISE COMPARISONS OF MEAN

ΔX IN GROUPS (right side condyle)	MEAN	HOMOGENEOUS GROUPS
CONTROL	0.700	I
ALUWAX	0.359	I
ZOE-PASTE	0.340	I
POLYETHER	0.113	I

There are no significant pairwise differences among the means of the groups along X axes-right condyle.

Table-II-f: Statistical comparison (by one way ANOVA) of the Hand articulated group, the groups mounted using Aluwax, ZOE, Polyether bite registration paste along Delta Z (right side condyle):

SOURCE	D.F	S.S	MS	F	P	REMARK
BETWEEN	3	1.139	0.379	0.40	0.750	NS
WITHIN	40	37.55	0.938		-	
TOTAL	43	38.69	-	-	-	-

Result shows no statistical significance at 1% level ($p < 0.01$) and at 5% level of significance. From the results of the above table the 4 groups show no significant difference along horizontal direction pertaining to the right condyles of the subjects used in the study.

TUKEY PAIRWISE COMPARISONS OF MEAN

ΔZ IN GROUPS (right side condyle)	MEAN	HOMOGENEOUS GROUPS
CONTROL	-1.38	I
ALUWAX	-1.136	I
ZOE-PASTE	-1.57	I
POLYETHER	-1.45	I

There are no significant pairwise differences among the means of the groups along Z axes-right condyle.

DISCUSSION: The success of any prosthesis depends upon whether the resultant maxillomandibular relationship is in harmony with the anatomy of the patient. This relationship is not the simple matter of mandibular opening and closing at the hinge movement. The opening and closing of jaws though appears to be simple, it's a complex relationship which exists in three dimensions, variation may occur in the vertical, anteroposterior or mediolateral position. In addition the vertical variation may be dissimilar on each side.

In addition to the structural and functional complexity, the recording and transfer of the actual maxillomandibular relation on to the articulator and identical reproduction of such positions or movements is difficult. Therefore recent articulators have been evolved and developed to simulate the patient's maxillomandibular relation and movements thus enabling

the dentist and the technician to study the dentition in function and construct restorations. A recording medium is necessary to record the patient's interarch relationship and then to transfer it to the articulator⁷. During the process of recording and transferring the relation, changes are common in vertical, transverse and horizontal dimensions of positions of the jaws. A material inserted between the maxillary and the mandibular teeth can cause deviation from normal intercuspal position in horizontal, vertical, antero-posterior and combined directions⁹.

In this study the shift in position of the condyle in the glenoid fossa or the representatives in the articulators due to changes in the viscosity, accuracy and dimensional stability, the resiliency of set interocclusal recording material were recorded using Mandibular position indicator.

This study was carried out to quantify and compare the variation in the position of the working models in 3 axes, mounted on the articulator. This instrument registers the 3 dimensional position of the mandible in relation to the cranium. The magnitude of the changes in position was quantified and compared.

The changes in the condylar position normally occur between the retruded contact position and the intercuspal position. The magnitude and the direction of these changes can be measured with the MPI. The mandibular position indicator consists of a modified upper member of SAM articulator with sliding cubes instead of condylar housings. The measurements are made between the condylar elements of the lower member and the sliding cubes of the upper member. The patented MPI records the measurements on the transverse axis within the intercondylar distance of the condylar elements of the articulator. Therefore this system has eliminated reciprocal readings and misinterpretations that are characteristic of measurements made outside the condylar elements⁸.

The MPI values enable to assess the variation in the position of the condyles. MPI readings showed slight variation in the positions of the working models mounted using hand articulation and different interocclusal records. Further the vertical difference in the, incisal pin and the incisal guide table (represents the changes in the occlusal surface contacts from RCP TO ICP) was represented as ΔH and ΔL respectively (table-I).

Statistical comparison of the Delta H, Delta L, Delta Y, Delta X & Z (both left and right) values of the control group with the groups mounted using interocclusal records was done. The comparisons are shown in table number IIa to IIc. Statistical analysis of the difference of MPI values between different groups was done using paired "t" test.

As the variation in the positions of the working models were minimal, statistical analysis did not show significant variations even at 5% level of significance.

Further, statistical intercomparison of the hand articulated groups, groups mounted using Aluwax, ZOE, Polyether bite registration paste along Delta H, Delta L, Delta Y, Delta X & Z (both left and right) was done. Statistical analysis by one way ANOVA between and within the groups as shown in Table- XI-a to g showed no significant result at 1% level of significance as well as 5 % level of significance.

Tukey pairwise comparison of means of all mounted groups was conducted. The comparison of means of all the groups in the study proved to have no significant pairwise differences among the means of the groups along all 3 axes as well as along Delta H, Delta L.

The centric relation concept followed by many dentists would position the condyles in the most posterior and superior position, but it is difficult for the dentists to evaluate whether or not they have actually established this position with their articulated mounted casts.

The differences in the condylar positions obtained when different interocclusal record materials are used can be explained in terms of magnitude of muscle

contraction⁹. This could be one of the reasons for the slight variation in the condylar positions, as recorded by the MPI along different axes when models were mounted using hand held, and different interocclusal record materials. When comparing the individual MPI values along different axes for the different groups used in the study at some instances the recordings done with aluwax showed a higher condylar positions. This could be because the jaw closure into the Aluwax record requires a single heavy muscle contraction permitting the molars to imprint on the Aluwax record thus displacing the condyles to the higher positions. In cases of ZOE bite paste and Polyether bite paste, the material requires several seconds to harden and it is difficult for the patient to maintain heavy muscle contraction during this time interval.

However, the overall comparison of the changes in the positions of the condyles among the different groups used in the study were proved to be statistically insignificant. (Table-II)

James R. Mc Kee¹⁰ compared the condylar positions achieved through bimanual manipulation to condylar positions achieved through masticatory muscle contraction against an anterior deprogrammer in the year 2005¹⁰. He found that in the absence of the influence of occluding teeth, the contraction of masticatory muscles will place the condyles into the same position as centric relation. The findings of the above mentioned study is in accordance with this investigation to evaluate the changes in the position of the different mounted models.

An acrylic jig which was used in the study which prevented the first point of posterior tooth contact, thus eliminating the muscle hyperactivity. The jig maintained the thickness of the record material used. This could have been one of the reasons for not having achieved a significant change in the position of the working models when different jaw relation recording materials were used.

LIMITATIONS OF THE STUDY:

1. Individual subject variability was a limitation factor. These included the form of the face, profile, freeway space which could not be standardized.
2. Only one method and one operator were used to record RCP. Anterior deprogrammer was used to record the RCP. But in all the cases RCP was recorded only once and by only one operator. This could have been one of the reasons for not having achieved a significant change in the position of the working models when different jaw relation recording materials were used.
3. The sample size used for the study was small. This might have lead to the statistical insignificant data.

FURTHER SCOPE:

Positional variation of condyles using reinforcement or stabilization of interocclusal records is yet to be evaluated. The effect of flow/viscosity of interocclusal

record material on ligament, capsule, meniscus and buffer-space needed to be evaluated may be difficult but not impossible.

The changes in mandibular positioning using either ICP or RCP or both for dentate subjects having different skeletal or dental occlusal relationship on larger sample size may be conducted.

In absence of a few teeth the proprioception may be affected. Hence, similar cases may be conducted in partially dentate subjects.

The complexity of recording and calculating the changes in the position of the condyles in three axes (evident from the adhesive grids) might have resulted in error. It was also observed that the position of the condyle shifted left/right or above/below in respective X, Y, Z axes resulted in (+) or (-) values for different subjects as well as for the interocclusal records. This resulted in higher standard deviation for the mean values of the studied population size. Therefore it is suggested to conduct studies on larger population size.

CLINICAL IMPLICATION:

The clinical variation might have affected the findings of this study resulting in to statistically nonsignificant changes in condylar position or occlusal fossa relationship. Therefore, it is suggested that for each patient more than one interocclusal record must be made in order to verify the accuracy of recordings as well as to have a transfer of the jaw relation on to the articulator.

CONCLUSION

Based on the findings within the limits of the study the following conclusions were drawn:

Among the different groups used in the study:

- 1) Irrespective of the material used for recording jaw relation, no 2 positions coincided with each other either for the pin relationship or condylar positions in different axes except in 2 cases.
- 2) No significant change in the position of the condyles were found among the mounted models, using Hand held articulation, Aluwax, Zinc oxide eugenol bite registration paste and Polyether bite registration paste.
- 3) No significant change in the position of the incisal pin and the incisal guide table (represents the changes in the occlusal surface contacts from

RCP TO ICP) were found among the mounted models, using Hand held articulation, Aluwax, Zinc oxide eugenol bite registration paste and Polyether bite registration paste.

Based on the above findings and the conclusion one can use the interocclusal record material of his/her choice for recording and for transfer of jaw relation accurately.

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