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Original article

A study to evaluate and compare right and left condylar discrepancy between centric relation and maximum intercuspation in three age groups

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ABSTRACT

Background: *Since discrepancy between centric relation and maximum intercuspation has been an area of interest for dental fraternity for decades, the study was conducted to expand the concepts of the same when age is taken into consideration.*

Objective: *This study was conducted to assess and measure the discrepancy between centric relation (CR) and maximum intercuspation (MI) at right and left condyles in three age groups, compare the discrepancy at right and left condyles between three age groups and right and left side condyles within the same age group.*

Methods: *Sixty healthy subjects were selected and divided into three groups of twenty subjects each. Group I: 18-25 years, Group II: 30-45 years and Group III: more than fifty years. Preliminary impressions were made. Orientation relation was transferred to a semi-adjustable arcon articulator. Subjects were guided into centric relation using Dawson's bimanual manipulation technique and centric interocclusal record was made. The mandibular cast was related to the maxillary cast using centric interocclusal record. The casts were then allowed to fall into maximum intercuspation and the distance that the condylar analogues had moved was measured using Feeler gauge.*

Results: *The mean CR-MI discrepancy in Group I was 0.417±0.137 mm and 0.364±0.123 mm, Group II was 0.528±0.160 mm and 0.512±0.158 mm and Group III was 0.873±0.228 mm and 0.815±0.172 mm at the right and left condyles respectively.*

Conclusion: *Within the limitations of the study it was concluded that all the sixty subjects had a CR-MI discrepancy in both left and right condyles. The variation in discrepancy between the three age groups was found to be very highly significant.*

Keywords: *Dawson's bimanual manipulation, centric discrepancy, temporo-mandibular disorders, age, centric relation*

Introduction

The discrepancy between centric relation (CR) and maximum intercuspation (MI) has been a field of interest for dental professionals for many decades. There has always been a debate on CR-MI discrepancy and the role of both in treatment aspects has also been of concern.

It has been widely accepted that approximately 90% of the individuals have a discrepancy between centric relation (CR) and maximum intercuspation (MI). [1,2] The role of CR-MI discrepancy in Temporo-Mandibular Disorders (TMD) has been debated extensively. [3,4] Though it has been said that TMD patients do have associated non-occlusal factors and that occlusal therapy should be deferred until acute symptoms are controlled, a significant difference between CR and MI has been found in symptomatic individuals. [5]

The importance of CR-MI discrepancy is not fully understood, but there are case reports suggesting its potential clinical implication. Gnathologists, who are associated with the morphology, histology, physiology, pathology, and the therapy of the jaws or

masticatory system, believe that large discrepancies can lead to breakdown of the joints. Even though numerous studies have been done to compare the discrepancies between CR and MI, there is not much information about the discrepancy between right and left side condyles amongst the same age group subjects. Also there have been no efforts in the past to compare the discrepancy amongst the three age groups at right and left condyle. The null hypothesis was that CR coincides with MI in all three age groups.

The present study was conducted to assess measure and compare CR-MI discrepancy at right and left condyles in subjects belonging to three age groups.

Materials and Methods

Sixty subjects from patients visiting the outpatient department of Department of Prosthodontics, AB Shetty Memorial Institute of Dental Sciences, Nitte University, Mangalore were selected for the study. These subjects were divided into 3 groups depending on their age:

Group I: Consisted of 20 subjects in the age group of 18-25 years.

Group II: Consisted of 20 subjects in the age group of 30-45 years.

Group III: Consisted of 20 subjects above 50 years of age.

General physical examination was conducted before starting the study and written consent to participate in the research and use the data was obtained from all the subjects. Subjects with symptoms of temporomandibular disorders (TMD), gross malocclusion, gross abnormalities of the jaws and neuromuscular disorders were excluded. Ethical clearance was obtained for the study.

Maxillary and mandibular preliminary impressions were made using alginate impression material (Zelgan Plus, Dentsply) using stock trays (GDC, Germany). Preliminary casts were poured using Type 3 Dental Stone (Kalabhai). Orientation relation of maxillary dental arch was recorded using arbitrary Facebow (Artex Rotofix- Amann Girrbach). This relation was transferred to semi-adjustable ARCON articulator (Artex articulator AP- Amann Girrbach) using a transfer slide device (Amann Girrbach). The maxillary cast was attached to the upper member of the articulator using mounting plaster (White Gold). The subject was made to sit in a dental chair which was reclined to bring subject in a supine position. Deprogramming was carried out by placing cotton rolls in premolar region on each side for 15 minutes to break muscle engrams. An anterior jig was fabricated using Greene stick compound (DPI Pinnacle tracing sticks). Subject's mandible was guided in to CR is using Dawson's bimanual manipulation technique. [6] Using this technique the subject was made to close in to the compound until posterior teeth just barely miss contacting. Wax interocclusal record material (Delar bite registration wax, Delar Corp. USA) was taken and one side was heated in hot water bath at 58oC for 1 minute to soften it. This softened side was pressed against subject's maxillary cast to get indentations of the maxillary teeth following which it was cooled in cold water. The non-indented side of wax was then heated in hot water to soften it. The wax wafer was adapted back to the subject's maxillary teeth and the subject was made to close into the indents of mandibular anterior teeth on the anterior jig. Care was taken to see that all mandibular posterior teeth made indentations on the bite recording wax. Once the wax cooled the record was chilled in cold water. This centric record

was verified and also evaluated extraorally to ensure that there were no perforations. The articulator was locked in centric and the mandibular cast was attached to the lower member of the articulator using mounting plaster. The articulator was programmed using protrusive interocclusal record. When the articulator was locked in centric the casts would occlude in centric occlusion and the condylar analogues would be at the posterior most in the housing. The articulator lock was then opened and the casts were brought into MI. The condylar analogue was examined for any forward movement and the distance was measured on the right and left side separately using Feeler gauges (Buffalo Tool Products) up to an accuracy of 0.04mm. The entire procedure was done by a single operator for all the cases.

Paired t test was used to compare the discrepancy between right and left sides for the same age groups ie. Intra-group variation. One-way Anova was applied to compare inter-group discrepancy for each side and Post-hoc tukey test was performed to compare the mean discrepancy for individual groups with other groups ie. Group I-Group II, Group II-Group III and Group I-Group III for right side and left side.

Results

The data collected was tabulated and analysed. When the CR-MI discrepancy was evaluated(Table 1), the subjects of Group I, Group II and Group III showed a mean discrepancy of 0.417±0.137 mm and 0.364±0.123 mm, 0.528±0.160 mm and 0.512±0.158 mm, 0.873±0.228 mm and 0.815±0.172 mm at right and left side respectively. When the CR-MI discrepancy on the right side amongst the three age groups was evaluated using one-way ANOVA test (Table 2), a statistically very highly significant ($p<0.001$) variation was noticed. A similar evaluation on the left side also showed a statistically very highly significant variation ($p<0.001$). The CR-MI discrepancy between two age groups on the right side and left side was compared using post-hoc tukey test (Table 3). The discrepancy between Group I and Group II on the right side showed a mean difference of -0.111 mm and standard error of 0.057 which was statistically not significant($p>0.05$), whereas statistically significant change ($p<0.001$) was noted between Group I and Group III with a mean difference of -0.456 mm and standard error of 0.057. The variation in discrepancy between Group II and Group III was also statistically significant ($p<0.001$) with a mean difference of -0.346 mm and standard error of 0.0567. On the left side, the discrepancy between Group I and Group II showed a mean difference of -0.147 mm and standard error of 0.048, which was statistically significant ($p=0.01$). Between Group II and Group III the mean difference was -0.451 mm with a standard error of 0.048 which was also statistically significant($p<0.001$). The mean difference of discrepancy between Group II and Group III was statistically significant with a value of -0.304 mm and a standard error of 0.048. The discrepancy between right side and left side within Group I, Group II and Group III were analysed using paired t-test (Table 1). Group I, showed a mean difference of 0.053±0.104 mm between right side and left side. This variation was found to be statistically significant ($p<0.036$). Similarly, the CR-MI discrepancy between right and left side were analysed for Group II and the mean difference was found to be 0.018±0.120 mm which was statistically not significant ($p=0.536$). In Group III the mean difference between right and left side was

0.058±0.212 mm. This value was statistically not significant. (p=0. 0.237)

Table 1: Comparison of right and left side discrepancy between CR and MI within group I, group II and group III

GROUPS			Mean± SD	Paired Difference	t	Sig. (2-tailed)
18-25 years	Pair 1	Right	0.417±0.137	0.053±0.104	2.256	0.036
		Left	0.364±0.123			
30-45 years	Pair 1	Right	0.528±0.160	0.018±0.120	0.631	0.536
		Left	0.510±0.158			
>50 years	Pair 1	Right	0.873±0.228	0.058±0.212	1.221	0.237
		Left	0.815±0.172			

***Paired t-test**

Table 2: Comparison of CR-MI discrepancy amongst all three age groups for right side and left side

Side		Mean±SD	Sig.
Right	Group I	0.417±0.137	<0.001
	Group II	0.528±0.160	
	Group III	0.873±0.228	
	Total	0.606±0.263	
Left	Group I	0.364±0.123	<0.001
	Group II	0.511±0.158	
	Group III	0.815±0.172	
	Total	0.563±0.241	

***One-way ANOVA test**

Table3: Comparison of CR-MI discrepancy between three age groups on the right side and left side

Dependent Variable	(I) GROUPS	(J) GROUPS	Mean Difference (I-J)	Sig.
Right	Group I	Group II	-0.111	0.132
		Group III	-0.456	<0.001
	Group II	Group III	-0.345	<0.001
Left	Group I	Group II	-0.147	0.01
		Group III	-0.451	<0.001
	Group II	Group III	-0.304	<0.001

***Post-hoc tukey test**

Discussion

The mandible is related to the maxilla in infinite possibilities. However, the relation of mandible to the maxilla that continues to be of concern to the dental fraternity is "centric relation". The concept of centric relation has changed over time and so has its definition. Currently, the most accepted definition is the one presented in GPT-5, which defines centric relation as "the maxillomandibular relationship in which the condyles articulate with the thinnest avascular portion of their respective disks with the complex in the

anterior-superior position against the shapes of the articular eminencies. This position is independent of tooth contact. This position is clinically discernible when the mandible is directed superior and anteriorly. It is restricted to a purely rotary movement about the transverse horizontal axis."[7]

Maximal intercuspal position (MI) is defined as "the complete intercuspation of the opposing teeth independent of condylar position, sometimes referred to as the best fit of the teeth regardless of the condylar position—called also maximal intercuspation". (GPT-8)[7] CR is a position which is independent of tooth contact. This position can be determined by manipulating the mandible in a purely rotary movement about the transverse horizontal axis. [8]

If any tooth incline comes into contact prematurely in centric relation, it guides the mandible in a position away from the centric. It is this discrepancy that current study had intended to measure. When this discrepancy occurs, the condyle is not in the favourable position to function. The favourable position is the thinnest avascular portion against the shapes of the articular eminences.

Hinge axis is an imaginary transverse line passing through the centres of the condyles. [9,10] The hinge axis is of clinical significance when the arc of closure or the axis of closure of the subject is to be transferred to an articulator. This will allow for replication of mandibular movements, reproduce paths travelled by cusps of teeth during this movement, and also alter the vertical dimension. [11]

In an ideal situation when CO and MI coincide and the occlusion is stable when the condyles are in CR i.e. there exists an orthopaedic stability of the joint. In this case the position is braced by ligaments which do not tend to tire or fatigue. However in the presence of a discrepancy, the maintaining of mandible in a convenience position by prolonged muscle contraction leads to muscle fatigue, muscle spasms or initiation of a bruxing pattern in an attempt to reduce or eliminate the occlusal interference causing muscular imbalance. The bruxism may wear teeth or it may loosen them. Hypermobility may lower the resistance to periodontal breakdown or it may affect the pulp, producing hypersensitivity of teeth. All these disruptions produce stress, and stress takes its toll in many ways, from simple acceleration of wear to complex, excruciating pain. [6]

The position of articular disc on the condyle is maintained by medial and lateral discal ligaments. These ligaments do not permit the disc to translate across the articulating surface of the condyle. When muscles tend to brace the mandible in a convenience position, the medial and lateral discal ligaments tend to be in a state of tension. Prolonged state of tension causes these ligaments to breakdown and elongate. Once elongated these ligaments cannot revert back to their original length. Hence the disc is allowed to slide over the condyle leading to disc displacement or even disc dislocation. [12]

Studies have indicated the absence of any significant discrepancy between the CR and MI in asymptomatic individuals [13], to presence of significant discrepancy in patients with headache and TMDs. [14] Kirveskari P has suggested that occlusal adjustment has an effect on chronic headaches and chronic neck and shoulder pain. [15] However, the presence or absence of discrepancy, and its variation with age largely remains unattended to. The importance of knowing the same as already been stressed earlier in this text. This study attempts to explore this aspect

of the occlusal variable by assessing and comparing the discrepancy between healthy adult individuals pertaining to three different age groups.

The CR-MI discrepancy was seen in all the subjects who participated in the study. Hence the null hypothesis was rejected. It is the ginglymo-arthrodial nature of the joint to hinge and translate that allows this CR-MI discrepancy to be accommodated. If it was for true hinging motion of the joint then this accommodation would not have been possible. When the CR-MI discrepancy was compared between the groups for the right side and for the left side, it could be noted that between Group I and Group II on the right side, there was no statistically significant discrepancy ($p=0.132$) while on the left side a statistically significant discrepancy was seen ($p=0.01$). When Group I was compared with Group III, and Group II was compared with Group III, a very highly significant discrepancy was seen for both right ($p<0.001$) and left sides ($p<0.001$). The reason for this could be the absence of any significant functional wear in subjects belonging to the first two groups. Also, with advancing age there is more attrition of teeth, as a result the mandible assumes more anterior position to get adequate force for mastication. This might be the reason for increased discrepancy in the elderly population.

It must be noted that even though there was CR-MI discrepancy, none of the subjects showed symptoms of any TMD. This study was conducted on three age groups consisting of twenty subjects in each. A similar study with a larger sample size would probably give a more definite value. Also, this study has evaluated discrepancy in a single plane. Further studies could be done to evaluate the discrepancy in three planes.

Since all the subjects selected for this study were healthy individuals with no symptoms of TMD, it is deemed not necessary to correct the CR-MI discrepancy. However, if subject does exhibit symptoms of TMD, it may be required to correct the discrepancy after eliminating other possible etiological factors. In case the subject has to undergo any extensive procedures like multiple fixed partial dentures or full mouth rehabilitation, it is advisable to correct the discrepancy before the start of treatment.

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