A STUDY ON THE EFFECTS OF CENTRIC RELATION OCCLUSION-MAXIMUM INTERCUSPATION DISCREPANCIES TO DENTAL WEAR

Min-Ah Hong, D.D.S., Ph.D., Kwang-Nam Kim, D.D.S., M.S.D., Ph.D
Seong-Joo Heo, D.D.S7., M.S.D., Ph.D.

Department of Prosthodontics, Graduate School, Seoul National University

I. Introduction

Temporomandibular joint (TMJ) and teeth, among various components of the stomatognathic system, had distinct functional movement different from other joints, due to their particular anatomic structure and neuromuscular system.[65] Centric position of mandible or the starting point of mandibular movement had two definitions ; centric relation (CR) and maximum intercuspation (MI).

The relationship of the two positions was important for occlusal analysis. Maximum intercuspation was a position determined by remaining upper and lower teeth. On the other hand, centric relation described by McCollum at first, was a position which was determined by the disk-condyle complex, ligament and muscle. Thus centric relation was a bone-to-bone relation. But, there had been much controversy over the definition, position, and its reproducibility of centric relation. The position of centric relation had seen very controversial. Most posterior,[55] most superior,[9,17] most superior-posterior,[26,39] most anterior,[10] anterior-superior position[11] were once thought to be correct.

Early gnathologists[6,59,60,68,83] proposed that centric relation (CR) would exist when the condyles were fully seated rearmost and uppermost in their respective fossae. However, ideal condylar position has led to much discussion, argument and confusion among dentists.[11,16,25]

Dawson[16] proposed that centric relation as "the most superior position of condyle-disk assemblies against eminentia, irrespective of tooth position of vertical dimension".

Otherwise Celenza[11] defined centric relation as anterior-superior position. Present knowledge strongly indicated that CR as the most superior-anterior position of the condyles against the posterior slope of the eminentia. Glossory of prosthodontic terms[3] adopted the definition of Celenza : "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 slopes of the articular eminences. This position is clinically discernible when the mandible is directed superiorly and anteriorly and restricted to a rotary about a transverse horizontal axis. This term is in transition to obsolescence."

Mandibular guidance methods were also proposed. They can be divided into two categories : the active methods and the passive methods. Active methods meaned guidance

by dentists or operators. Passive methods implied guidance by the patient's himself. In active methods, there were chin point guidance,[56] bilateral manipulation,[17] chin point guidance with anterior jig,[9] chin point guidance with leaf gauge,[36,55] power centric method.[75]

When mandible moved from CR position to MI position, 2 kinds of mandibular movements (translation and rotation) or three dimensional movements occurred.

Gnathologists proposed that point centric, the coincidence of CR and MI, was the ideal centric position. But, majority of the population showed CRO-MI discrepancies. Posselt,[69] Dawson,[17] Reider,[71] and Lucia[56] reported that 80−90% of subjects showed CRO-MI discrepancies. Kydd and Sander,[36] Ingervall,[30] Mcnamara and Henry,[61] Hickey,[33] Azarbal[4] reported that all subjects showed CRO-MI discrepancies. In 1952, Posselt[69] reported that a discrepancies existed between centric relation contact position (CRCP) and the intercuspal position (IP) in approximately 90% of the subjects. Hodge and Mahan[36] graphically described the mandibular path between these two positions. In 30 subjects who had excellent occlusion, the mean value of the anterior-posterior component measured at the incisors was 0.75 ㎜ and the mean value of vertical component was 0.8㎜. Rosner[73] diagrammatically depicted the horizontal and vertical component. In 1986, Wise[87] reported on the clinical observation that patient having a greater horizontal than vertical component to be slide from CRCP to the IP as measured at the incisors. In 1992, Wise[88] reported the relationship between the vertical-horizontal ratio of movement. Lucia[56] believes that the correct centric relation as essential for coordination of occluding tooth surfaces and the temporomandibular joint (TMJ).

Measuring methods of CRO-MI discrepancies were as follows : Intraoral direct method using a ruler, position-gnathometer,[36] articulator mounting,[75,77,80] gothic arch tracing,[38] photoelectric Mandibulography,[5] Electromyography analysis, Visi-trainer.[51]

Dental wear appears to be a general physiologic phenomenon found in all mammals, in every civilization and at all ages. But, there are many factors that can influence the type and rate of wear.[8,15,23,40,62,63,87] Although several studies have provided important information about the anatomy and origin of dental wear, the precise causes remain unclear. While numerous efforts have been made to implicate various factors in the etiology of tooth wear,[19,22,31,32,42,53,58,66,76,81,84,92] the evidence in the literature is inconclusive. Furthermore, the multifactorial character of occlusal tooth wear and those etiologic factors, and combinations thereof, which may contribute to the wear experienced by a given individual remain difficult to identify.[8,40] Because there is always a combination of the various processes.

The relatively few studies of tooth wear in present-day normal populations refer mainly to adults.[13,40,45,50,67,90] This lack of detailed knowledge was partly due to difficulties in measuring techniques. The most frequently used method were based on clinical grading of the amount of worn tooth substances. Since the wear of teeth in contemporary industrialized population was small, the ordinal scale of these method was not sensitive enough for the study of tooth wear in the normal young permanent dentition.[64]

Planimetric methods[74] and arbitrary scale[90] provided a continuous and more accurate scale that made it possible for detailed information to be gained, comparison to be made, and trends to be discovered. In 1987, Gourdon [27] found that values obtained by the planimetric methods and Woda's arbitrary scale sho-

wed significant correlation for quantification of dental wear.

In 1970, Reynolds[72] reported that the number and extent of facets of wear on all teeth seemed to be more closely related to the length of slide rather than the age of the individual.

The purposes of this study were 1) to evaluate the effects of CRO-MI discrepancies on the dental wear 2) to evaluate the difference of dental wear between initially contacted teeth in CR and the other teeth.

II. Material and Methods

A. Material

The preliminary survey was conducted on 260 students of Seoul National University Dental College who had a complete healthy dentition and were between 21 & 25 years of age. Their selection was predicated on the following criteria : absence of missing teeth (except third molars), caries, periodontal disease, bruxism, TMJ disorders, restorations, and history of occlusal or orthodontic therapy. Furthermore, good occlusion with molar relationship in Angle class I and coincidence between maxillary and mandibular midlines were present, along with regular teeth alignment. The third molars, when present, were not included in the analysis.

To except from other factors related to dental wear, the questionnaire related to possible background factors of importance for dental attrition (for example, dietary, environmental, working, and parafunctional factors), signs and symptoms of functional disturbances of the masticatory system and recurrent headache was performed on 260 persons (Table I, II, III).

According to the results of the questionnaire, some people who had possible factors of importance for dental wear of functional disturbances of the masticatory system were excluded, only 50 out of 260 students of Seoul National University dental college were suitable for this study.

The SAM2 articulator (SAM Prazisionstechnik GmbH, Germany) (Fig. 1) and Mandibular Position Indicator (MPI) (Fig. 2) were

Table I. Some of the questions related to dental attrition

Question	Yes, now	Yes, previously but not now	No
Do you spend much time in a dusty environment ?			#
Do you sometimes use your teeth in your work ?			#
Have you had a dry mouth for a long period of time ?			#
Do you often have 'heart burn' (acid regurgitation) ?			#
Do you often vomit ?			#
Do you often clench or grind your teeth ?			#

: used answer in this study.

Table II. Dietary habits related to dental attrition

Does your diet include/··· ?	1-2 times a month	1-2 times a week	daily
Citrus fruits		#	
Apples		#	
Tomatoes		#	
Grapes		#	
Coke/Pepsi		#	
Fruit juices		#	
Cider		#	

: used answer in this study.

Table III. Some reported symptoms related to functional disturbance of the masticatory system

Do you sutfer from/··· ?	Yes, now	Yes, previously but not now	No
Frequent headache			#
Pain in your jaws and/or face			#
Dizziness (Vertigo)			#
Tinnitus			#

: used answer in this study

used to investigate discerpancies between centric relation occlusion and maximum intercuspation discrepancies.

The preliminary study showed two patterns of CRO-MI discrepancies. One type was a group of small discrepancies. At sagittal plane, horizontal discrepancies were under 0.5㎜, vertical discrepancies were under 0.5㎜. At frontal plane, lateral discrepancies were under 0.3㎜. This type hereinafter was called Group 1 (Fig. 3). The other type showed large discrepancies. At sagittal plane, horizontal discrepancies were over 1.5㎜, vertical discrepancies were over 1.5㎜. At frontal plane, lateral discrepancies were over 0.5㎜. This type hereinafter was called Group 2 (Fig. 4). Of these 50 persons, 20 persons within the above criterias were selected for this study. There were 10 persons in Group 1 (Age 23± 2yrs, 9 males and 1 female), and 10 persons in Group 2 (Age 23± 2yrs, 9 males and 1 female).

B. Methods

Maxillary and mandibular impression were made using an irreversible hydrocolloid material (Alginate, Aroma-Fine II, GC, Japan) in perforated Aluminum stock trays. A maximum intercuspation (MI) bite registration was taken with bite registration wax (Alminax, Associated dental product, England) and zinc eugenol paste (Temp-Bond, Kerr, USA). Subjects were instructed to bite completely through the softened wax into maximum intercuspation position.

A centric relation (CR) bite registration was then taken by Dawson's method.[6] Before ta-

king the CR bite registration, the muscle deprogramming was done. The subjects hold the cotton roll at incisors for 5 minutes. 2 sets of CR bite registration were made for verification of CR record. Different sets of CR bite registrations were made by other examiner for evaluation of inter-individual differences.

The maxillary and mandibular alginate impressions were poured immediately using dental stone (Whipmix, USA). Both sections of the CR bite registration were carefully trimmed with a scalpel blade so that only indentation for the cusp tip.

A SAM2 Articulator was used for mounting maxillary and mandibular casts. The maxillary casts were mounted using the ear face-bow transfer provided to locate the estimated hinge axis. The face-bow was oriented on a line parallel to axis-orbital plane by employing soft tissue Nasion as the anterior reference point. All casts were mounted on the articulaor using fast-setting stone (Samwoo, Korea). To minimize the effect of gypsum's expansion, the mounting procedure was done by two steps. The split casts using magnet were used for verification of CR bite registration (Fig. 5). After each mounting, initial tooth contact at CR was marked.

The centric slides were assessed in the sagittal plane at the articulator condyles using a Mandibular Position Indicator (MPI). This device can measure the three-dimensional changes in the position of the articulator condyles between centric relation and maximum intercuspation. Sagittal plane and frontal plane were examined for this study. The horizontal and vertical changes in the sagittal plane at each articular condyle correspond to the ΔX and ΔZ changes respectively on the adhesive grids affixed to the sliding blocks on the MPI (Fig. 6). The X and Z values at the left and right condylar mechanism were marked with articulating paper. The lateral changes were read at dial gauge (ΔY)

(1) Dental wear analysis by use of ordinal scale

The ordinal scale was used to measure dental wear values in a subject's mouth. The following scale was applied to evaluate degrees of dental wear : 0=no or little wear of enamel only ; 1=marked wear facets of enamel ; 2 =wear into dentin ; 3=extensive wear into dentin($>2mm^3$) ; and 4=wear into secondary

Table Ⅳ. Ordinal scale used for grading severity of occlusal wear

Grade	Degree of occlusal wear
0	No visible facets in enamel ; occlusal/incisal morphology intact
1	Marked wear facets in enamel ; occlusal/incisal morphology altered
2	Wear into dentin ; dentin exposed ; occlusal/incisal morphology changed in shaped with height
3	Extensive wear into dentin ; larger dentin area($>2mm^3$) exposed ; occlusal/incisal morphology totally lost locally or generally ; substantial loss of crown height
4	Wear into secondary dentin

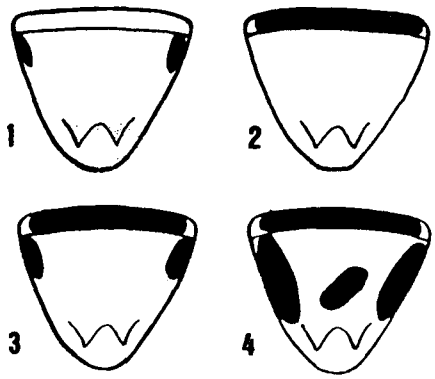

Fig. 7. Diagram of arbitrary criteria chosen to quantify wear facet of incisors and canines[90]

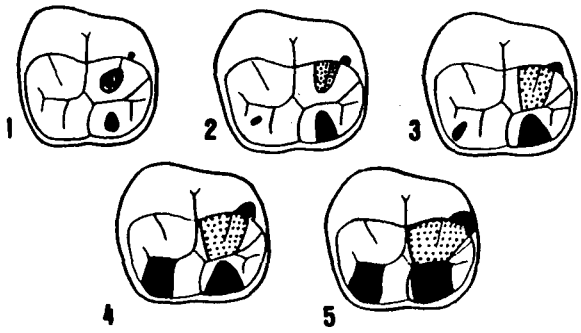

Fig. 8. Diagram of arbitrary criteria chosen quantify wear facet of molars and premolars[90]

dentin (Table Ⅳ). On the basis of these criteria, the assessment was performed on subjects through clinical oral examination.

(2) Dental wear analysis by use of arbitrary scale

The arbitrary scale was used to quantify the surface of wear facets on the casts. Arbitrary scale was used for both the anterior and the posterior teeth.

A wear of anterior teeth was evaluated by the arbitrary value (Fig. 7) as follows :

1=One or severals facets located only on the palatal or buccal surface of the tooth

2=One or severals facets present only on the incisal edge

3=One or severals facets present on the incisal edge and also on the palatal or buccal surfaces, but occupying less than one third of longitudinal length of tooth crown.

4=One or severals facets present on the incisal edge and also on the palatal or buccal surfaces, and occupying more than one third of longitudinal length of tooth crown.

A wear of posterior teeth was evaluated by the arbitrary value (Fig. 8) as follows :

1=Facets occupying in buccolingual direction less than one third of cusp side

2=Facets occupying in buccolingual direction more than one third of cusp side

3=Facets occupying a total cusp side

4=Facets occupying in buccolingual direction three complete cusp side (external working, internal working, and non-working) that are not situated in the same frontal plane

5=Facets occupying in buccolingual direction three complete and contiguous cusp sides situated in the same frontal plane.

(3) Statistical analysis

Differences between groups were tested by means of t-test (SPSS/PC+) and paired t-test. The level of statistical significance used was $p<0.05$.

Ⅲ. Results

(1) The means and standard deviations of CRO-MI discrepancies

The means and standard deviations of CRO-MI discrepancies shown at Table Ⅴ and Fig. 9.

Table V. CRO-MI discrepancies(Unit : mm)

Variables	Group 1	Group 2
ΔX(R)	0.26± 0.18	2.06± 0.71
ΔX(L)	0.29± 0.21	2.45± 0.90
ΔZ(R)	0.27± 0.20	2.48± 0.81
ΔZ(L)	0.28± 0.18	2.21± 0.97
ΔY	0.30± 0.25	0.59± 0.52

Table VI. Mean dental wear(ordinal scale) ($p<0.05$)

Variables	Group 1	Group 2
Mean	1.179	1.263
S.D	0.122	0.215

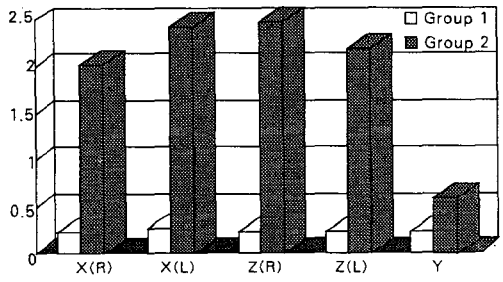

Fig. 9. The CRO-MI discrepancies

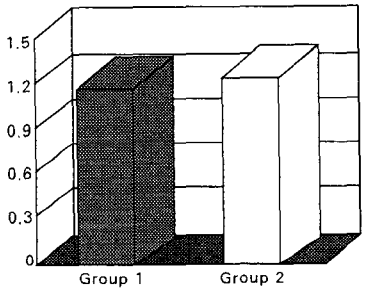

Fig. 10. The mean dental wear value (ordinal scale)

(2) The dental wear values obtained by use of ordinal scale

Means and standard deviations were calculated for each group in all teeth. Figures were used for a comparative study of the dental wear values between the Group 1 and Group 2 subjects.

1. The mean dental wear value in all teeth, obtained by use of ordinal scale, was not significantly different between the Group 1 and Group 2 ($p<0.05$) (Table VI, Fig. 10).

2. The dental wear values in initially contacted teeth and the other teeth by ordinal scale was not significantly different between the initialiy contact teeth and the other teeth ($p<0.05$) (Table VII, Fig. 11).

3. The dental wear values in initially contacted teeth and the other posteior teeth by ordinal scale was not significantly different between the initially contact teeth and the other posterior teeth ($p<0.05$) (Table VII, Fig. 11).

(3) The dental wear values obtained by use of arbitrary scale

Means and standard deviations of dental wear values were calculated for each group in all teeth and between teeth.

1. The mean dental wear value in all teeth,

Table Ⅶ. Dental wear scores of initial contacted teeth & the other teeth(ordinal scale) ($p<0.05$)

Variables	I.C	N.I.C.	N.I.C.(post)
Mean	1.183	1.291	1.149
S.D	0.241	0.262	0.374

I.C. : Initially contacted teeth

N.I.C. : The other teeth except initially contacted teeth

N.I.C.(post) : The other posterior teeth except initially contacted teeth

Table Ⅷ. Mean dental wear(arbitrary scale) ($p<0.05$)

Variables	Group 1	Group 2
Mean	1.958	2.085
S.D	0.201	0.327

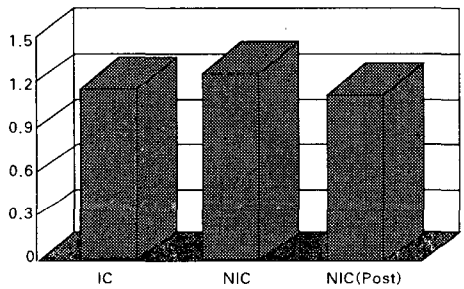

Fig. 11. The dental wear value of initially contacted teeth, the other teeth and the other posterior teeth (ordinal scale)

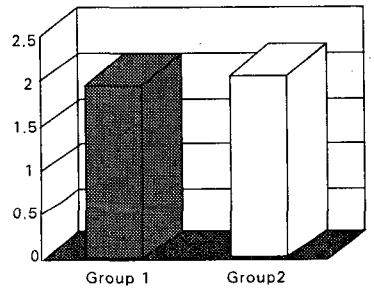

Fig. 12. The mean dental wear value (arbitrary scale)

Table Ⅸ. Dental wear scores of initial contacted teeth & non-initial contaced teeth(arbitrary scale) ($p<0.05$)

Variables	I.C	N.I.C.	N.I.C.(post)
Mean	2.767	2.015	2.041
S.D	0.875	0.384	0.562

I.C. : Initially contacted teeth

N.I.C. : The other teeth except initially contacted teeth

N.I.C.(post) : The other posterior teeth except initially contacted teeth

obtained by use of arbitrary scale, was not significantly different between group 1 and group 2 ($p<0.05$) (Table Ⅷ, Fig. 12).

2. The dental wear values in initially contacted teeth and the other teeth by arbitrary scale were significantly greater in initially contacted

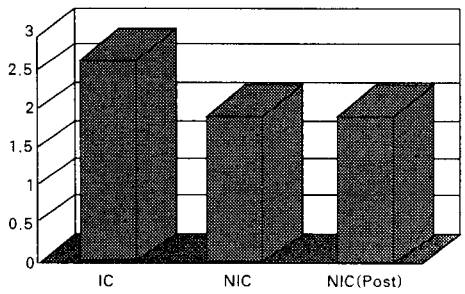

Fig. 13. The dental wear value of initially contacted teeth and the other posterior teeth (arbitrary scale)

teeth than the other teeth ($p<0.05$) (Table Ⅸ, Fig. 13).

3. The dental wear values in initially contacted teeth and the other posterior teeth by arbitrary scale were significantly greater in initially contacted teeth than other posterior teeth ($p<0.05$) (Table Ⅸ, Fig. 13).

Ⅳ. Discussion

The position of mandible could be determined by two means. One was decided by contact of intercuspation between mandibular and maxillary teeth. The other was decided by the position of the condyle in the articular eminence. Maximum intercuspation was tooth-to-tooth relation, at which the contact surface between the upper and lower teeth become maximal. Centric relation was the positional relationship between the condyle and articular eminence, and due to its stability and reproducibility, it was recognized that CR was reference point in mandibular movement. But, there were many argument[35,41] over its precise position.

Weinberg,[86] Hobo,[35] Hoffman[37] persisted that at centric relation, the condyle existed in the most posterior position. Dawson,[17] Long,[54] Carroll[9] the upper most position was CR. Stuart,[83] Glosen[26] supported the most superior-posterior position, Celenza[11] the anterior-superior position, Graham[28] the most anterior position.

Also many CR guide methods were reported by various dentists. Several studies used Dawson's bilateral manipulation methods.[4,55,57,78] This methods was effective in achieving most superior position of condyle. The method using leaf gauges was useful due to its removal of latent error. So, using the patient's own muscle power, the condyles existed in the most superior position. Chin point guidance with anterior jig method was effective in attaining condyle's most posterior position.[55,56]

On the other hand, some persisted that when guiding the mandible to the CR position excessive pressure on the mandible triggered a protective myo-reflex. Thus, active method without operator's guidance is more useful.[1]

There were many reports on CRO-MI discrepancies. Posselt[69] examined the CRO-MI discrepancies at incisal edge with gothic arch tracing. Many of normal population condyle's CRO and MI did not coincide. Reider[71] reported that CRO-MI discrepancies existed in 80% of the subjects in the anterior-posterior and vertical direction. And 30% of subjects showed lateral discrepancies. Pullinger[70] reported that 71% of the subjects showed discrepancies. Among them 61% under 1㎜. Solberg, de Laat[18] reported similar frequency and degree of discrepancies. Kydd,[10] Ingervall,[30] McNamara,[61] Hickey[33] reported that all the subjects showed discrepancies, and the amount of discrepancies about 1㎜. In all the reports, lateral discrepancies has been considerably lesser than anterior-posterior and vertical discrepancies. That was coincide with my study.

Measuring CRO-MI discrepancies in the condylar area is more complex than measuring

them in the incisal edge area. Articulators, Veri-check, Radiograph, Hinge axis locator have been used.[12,51,83]

Regarding the guidance method in jaw movement recording, Guichet,[29] McCollum and Stuart[60] claimed that measurement by the patient himself as sufficed as there were no movement by the patient other than voluntary border movement, Huffman,[39] Tupac[85] claimed that manipulation by the operator was necessary to overcome lateral occlusal interference and Simonet[79] reported that all voluntary movement existed within the boundaries of manipulation. A great deal of controversies existed regarding the effects of CRO-MI discrepancies. CRO-MI discrepancies was the most frequent feature of occlusal discrepancies, also Gelb[24] proposed that occlusal discrepancies or disharmonies may represent a major factor in the development of TMJ dysfunction.

There are few papers about occlusal discrepancies and dental wear. Egermark-Eriksson[20] stated that occlusal discrepancies increased according to the severity of dental wear. But that was a longitudinal study and the subjects were children.

Many different clinical techniques are currently used to obtain centric jaw relation records. Bilateral manipulation[16] is an operator guided manipulation to attempt to seat the condyles in the most superior position. This method has been proved to have the most consistent reproducibility.[34,46]

In this study CR bite registrations were verified by split cast technique. 9 out of 10 subjects showed an initial contact on the most posterior tooth at CRO. And, 8 out of 9 subjects showed initial contact only most posterior teeth, but 1 out of 10 subjects showed second premolars and second molars. Only 1 subject showed initial contact at second premolars. Most of subjects showed coincidence of ΔX and ΔZ. Perhaps, this was why the condyle cannot move forward or backward from centric relation without moving downward. A few case showed large ΔX and small ΔZ at right side and small ΔX large ΔZ at left side, and vice versa. Probably these cases were due to large lateral displacement or rotation of condyle and occult TMJ problems. Pullinger[70] reported that 26% of subjects showed right-left asymmetry.

In 1985, Smith[81] reported that dietary and regurgitation erosion were the most common causes of tooth wear, attrition was secondary in importance to erosion and abrasion the least important.

In 1990, Ekfeldt[21] reported that factors correlated with increased incisal and occlusal wear were number of existing teeth, age, sex, occurrence of bruxism, use of snuff, and saliva buffer capacity.

In 1991, Johansson[43] reported that the factors found to correlated significantly with increased occlusal wear were bruxism, biting habit and high intake of fruit juices.

In 1993, Dahl[14] reported that there were many factors that could influence the type and rate of wear. These factors were time/age, gender, occlusal conditions, hyperfunction, bite force, gastrointestinal disturbances, nutrition, environmental factors, salivary factors, and other factors.

In 1993, Johansson[44] reported that the factors of importance for occlusal wear were : age, increased bite force, decreased occlusal tactile sensitivity, increased endurance time, and reduced tendency for crowding in the dental arches and salivary factors (low buffer capacity and low rate of secretion).

In 1994, Abdullah[2] reported that the prevalence and severity of occlusal tooth wear and their interrelationship with lateral and protrusive occlusal contact schemes in a young adult

Indian population. No differences in the severity of wear were found in relation to lateral excursive and protrusive contact scheme.

The dental wear values, obtained by use of ordinal and arbitrary scale, were not significantly different between the Group 1 and Group 2. And dental wear value, obtained by use of ordinal scale, were not significantly different between initially contacted teeth and the other teeth. But dental wear value, obtained by use of arbitrary scale was significantly greater in the initially contacted teeth than the other teeth. The possible reasons for differences are as follows : First, the ordinal scale is not sensitive enough for the study of dental wear in the normal young permanent dentition. Second, the problem of the wear in initially contacted teeth was not the intensity but the amount. Third, wear seems to be multietiological phenomenon.

In this study, all dental arches presented wear facets. But, no extensive wear was observed beacause factors that could effect the dental wear were excluded. The molars and anterior teeth showed larger facet than premolar except initially contacted teeth. This meaned that initially contacted teeth at CR worn easily than the other teeth. Reynolds[72] reported that the number and extent of facets of wear was related as follows :

1) The length of the slide from terminal hinge relation to maximum intercuspation, 2) A lack of eccentric 'disclusion' of the posterior teeth. This finding was supported by Kim.[49] Kim reported that grinding type worn more easily than the chopping type.

V. Conclusions

10 subjects with small CRO-MI discrepancies and 10 subjects with large CRO-MI discrepancies were selected by use of SAM2 articulator. The mean dental wear values, obtained by ordinal scale and arbitrary scale, were calculated for each group. The dental wear values of initially contacted teeth and the other teeth were compared.

1. The mean dental wear value in all teeth, obtained by use of ordinal scale and arbitrary scale were not significantly different between the small discrepancies group and large discrepancies group.
2. In large discrepancies group, the initially contacted teeth did not show more intense wear than other teeth.
3. In large discrepancies group, the initially contacted teeth showed more amount of wear than the other teeth.

References

1. Abdel-Hakin AH. The swallowing position as a centric relation record. J Prosthe Dent 1982 ; 47 : 12-5
2. Abdullah A, Sherfudhin H, Omar R, Johansson A. Prevalence and severity of occlusal tooth wear and its relationship to lateral and protrusive contact schemes in a young adults Indian populations. Acta Odontol Scand 1994 ; 52 : 191-7
3. The Academy of prosthodontics. Glossory of prosthetic terms. J prosthe Dent 1994 ; 71 : 59
4. Azarbal M. Comparison of myo-monitor centric position to centric relation and centric occlusion. J Prosthe Dent 1977 ; 38 : 331-7
5. Barrie RO. Photoelectric mandibulography. J Prosthe Dent 1967 ; 17 : 109-21
6. Bennett NG. A contribution to the study of the movements of the mandible. Proceeding of the Royal Society of Medicine 1908 ; 1 : 79
7. Beyron H. Occlusal relations and mastica-

tions in australian aborigines. Acta Odontol Scand 1964 ; 22 : 597-678
8. Carlsson GE, Johansson A, Lundqvist S. Occlusal wear ; a follow-up study of 18 subjects with extremely worn dentition. Acta Odontol Scand 1985 ; 43 : 83-90
9. Carroll WJ, Woelfel JB, Huffman RW. Simple application of anterior jig or leaf gauge in routine clinical practice. J Prosthe Dent 1988 ; 59 : 611
10. Celenza FV. The centric position : Replacement and character. J Prosthe Dent 1973 ; 30 : 591-8
11. Celenza FV. The theory and clinical management of centric position II : centric relation and centric relation occlusion. Int J Periodont Restor Dent 1984 ; 4 : 62-86
12. Choi JW, Choi DG, Park NS, Choi BB. A comparative study on the reproducibility and the displacement of CR records. J Korea Acade Prostho 1988 ; 26 : 133-51
13. Dahl BL, Krogstad BS, gaard B, Eckers-Berg T. Differences in functional variables, fillings, and tooth wear in two group of 19-year-old individuals. Acta Odontol Scand 1989 ; 47 : 35-40
14. Dahl BL, Carlsson GE, Ekfeldt A. Occlusal wear of teeth and restorative materials : A review of classification, etiology, mechanisms of wear some aspects of restorative procedures. Acta Odontol Scand 1993 ; 51 : 299-311
15. Davies TGH, Pederson PO. The degree of attrition of decidious teeth and first permanent molars of primitive and urbanized Greenland natives. Br Dent J 1955 ; 99 : 353-434.
16. Dawson PE. Evaluation, diagnosis, and treatment of occlusal problems. St Louis : C.V.Mosby ; 1989 : 28-55
17. Dawson PE. centric relation-Its effect on occluso-muscle Harmony. Dent Clin North Am 1979 ; 23 : 169-80
18. De laat A, Van Steenberghe D. Occlusal relationships and temporomandibular dysfunction, part I : Epidemiologic findings. J Prosthe Dent 1985 ; 54 : 835-42
19. Eccle JD, Jenkins WG. Dental erosion and diet. J Dent 1974 ; 2 : 153-9
20. Egermark-Eriksson. A long term epidemiologic study of the relationship between occlusal factors and mandibular dysfunction in children and adolescents. J Dent Res 1987 ; 66 : 66-71
21. Ekfeldt A, Hugoson A, Bergendal T, Helkimo M. An individual tooth wear index and an analysis of factors correlated to incisal and occlusal wear on an adult Swedish population. Acta Odontol Scand 1990 ; 48 : 343-9
22. Enbom L, Magnusson T, Wall G. Occlusal wear in miners. Swed Dent J 1986 ; 10 : 165-70
23. Fareed K, Johansson A, Omar R. Prevalence and severity of occlusal tooth wear in a young Saudi population. Acta Odontol Scand 1990 ; 48 : 279-85
24. Gelb H, Bernstein I. Clinical evaluation of two hundred patients with temporomandibular joint syndrome. J Prosthe Dent 1983 ; 49 : 234-43
25. Gilboe DB. Centric relation as treatment position. J Prosthe Dent 1983 ; 50 : 685-9
26. Glosen LF, Shaw AF. Use of leaf gauges in occlusal diagnosis and therapy. Quintessence Int 1984 ; 6 : 611-20
27. Gourdon AM, Buyle-Bodin Y, Woda A, Faraj M. Development of an abrasion index. J Prosthe Dent 1987 ; 57 : 358-61
28. Graham MM, Buxbaum J, Staling LM. A study of occlusal relationships and the incidence of myofacial pain. J Prosthe Dent 1982 ; 47 : 549-55
29. Guichet NF. Occlusion : A teaching ma-

nual. Ahaheim, Calif. : Denar Corp. ; 1970
30. Hart KK, Sakamura JS. Mandibular lateral side shift and need for gnathologic instrumentation. J Prosthe Dent 1985 ; 54 : 415-20
31. Helkimo E, Carlsson GE, Helkimo M. Bite force and state of dentition. Acta Odontol Scand 1977 ; 35 : 297-303
32. Hellstrom I. Oral complication in anorexia nervosa. Scand J Dent Res 1977 ; 85 : 71-86
33. Hickey JC. Mandibular movement in three dimension. J Prosthe Dent 1963 ; 13 : 72-92
34. Hobo S, Iwata T. Reproducibility of mandibular centricity in three dimensions. J Prosthe Dent 1985 ; 53 : 649-54
35. Hobo S. Oral rehabilitation. Tokoy : Med. Dent. Pharm. Publish. Co. : 1968
36. Hodge LC, Mahan PE. A study of mandibular movement between from centric occlusion to maximum intercuspation. J Prosthe Dent 1967 ; 18 : 19-30
37. Hoffman PJ, Silverman SI, Garfinkel L. Comparison of condylar position in centric relation and centric occlusion in dentulous subjects. J Prosthe Dent 1973 ; 30 : 582-8
38. Howard FS, Smith Jr. A comparison of empirical centric relation records with location of terminal hinge axis and apex of the Gothic arch tracing. J Prosthe Dent 1975 ; 33 : 511-20
39. Huffman R, Regenos JW, Taylor RD. Principle of occlusion : Laboratory and clinical teaching manual. Columbus, Ohio : H&R Press. ; 1969
40. Hugoson A, Bergendal T, Ekfeldt A, Helkimo M. Prevalence and severity of incisal and occlusal tooth wear in an adult Swedish population. Acta Odontol Scand 1988 ; 46 : 255-65
41. Jang IT. Clinical significance of centric relation. J Korean dental Assoc 1983 ; 21 : 705-11
42. Jemt T. Masticatory mandibular movements. Swed Dent J 1984 ; 23(suppl) : 36
43. Johansson A, Fareed K, Omar R. Analysis of possible factors influencing the occurrences of occlusal tooth wear in a young Saudi population. Acta Odontol Scand 1991 ; 49 : 139-45
44. Johansson A, Haraldson T, Omar R, Kiliaridis S, Carlsson GE. A system for assessing the severity and progression of occlusal tooth wear. J Oral Rehabil 1993 ; 20 : 125-31
45. Kampe T, Hannerz H, Storm P. Facet pattern in intact and restored dentitions of young adults : A comparative study. Acta Odontol Scan 1984 ; 44 : 225-33
46. Kantor ME, Silverman SI, Garfinkel L. Centric relation recording technique-A comparative investigation. J Prosthe Dent 1972 ; 28 : 593-600
47. Kim KN. Record of mandibular movement. J Korean dental Assoc 1983 ; 21 : 783-91
48. Kim MK. Applied head and neck anatomy. Seoul : Dental Study Co. ; 1984
49. Kim SK, Kim KN. A study on the effects of chewing patterns to occlusal wear. J Korea Acade Prostho 1997 ; 35 : 15-30
50. Lambrechts P, Bream M, Vuylsteke-Wauters M, Vanherle G. Quantitative in vivo wear on human enamel. J Dent Res 1989 ; 68 : 1752-4
51. Lee JH, Kim KN, Chang IT. A comparative study of the effect of the CR-CO discrepancy on the mandibular movements. J Korea Acade Prostho 1991 ; 29 : 295-317
52. Lee JY, Kim KN. An experimental study on reproducibility and the position of cen-

tric relation and myocentric. J Korea Acade Prostho 1986 ; 24 : 45-54
53. Lincosalo E, Makkanen H. Dental erosion in relation to lactovegeterian diet. Scand J Dent Res 1985 ; 93 : 436-41
54. Long JH. Location of terminal hinge axis by intraoral means. J Prosthe Dent 1970 ; 23 : 11-24
55. Long JH. Locating centric relation with a leaf gauge. J Prosthe Dent 1973 ; 29 : 608-10
56. Lucia VO. A technique recording centric relation. J Prosthe Dent 1964 ; 14 : 494-505
57. Lucia VO. Modern gnathology concepts-updated. Chicago : Quintessence Publishing Co. ; 1983 : 146-7
58. Mannerberg F. Saliva factors in cases of erosion. Odonto Rev 1963 ; 14 : 156-166
59. McCollum BB. Fundamentals involved of prescribing restorative dental remedies. Dental Items of Interest 1939 ; 61 : 522, 724,852
60. McCollum BB, Stuart CE. A Research Report (Gnathology). South Passadena, Ca. : Scientific Press. ; 1955
61. Mcnamara DC, Henry PT. Terminal hinge contact in dentition. J Prosthe Dent 19 74 ; 32 : 405-11
62. Molnar S. Human tooth wear tooth function and cultural variability. Am J Phys Anthrop 1971 ; 34 : 175-90
63. Molnar S, McKee JK, Molnars IM, Przybeck TR. Tooth wear rates among contemporary Australian aborgines. J Dent Res 1983 ; 62 : 562-5
64. Nystom M, Kononen S, Alauusua S, Evarahti M, Vartiovaara J. Development of horizontal tooth wear in maxillary anterior teeth from five to 18 years of age. J Dent Res 1990 ; 69 : 1765-70
65. Okeson JP. Fundamentals of occlusion and temporomandibular disorders, St. Louis : The CV mosy Company ; 1985
66. Pindborg JJ. Pathology of dental hard tissues. Copenhagen : Munksgaard ; 1970
67. Pollmann L, Berger F, Pollmann B. Dental abrasion. Gerodontics 1987 ; 3 : 94-6
68. Posselt U. Physiology of Occlusion and Rehabilitation, ed.2. Oxford : Blackwell ; 1968.
69. Posselt U. Studies on the mobility in the human mandible. Acta Odontol Scand 1952 ; 10(suppl 10) : 3
70. Pullinger AG, Seligman DA, Solberg WK. Temporomandibular disorders, part I : Functional status, dentomorphologic features, and sex difference in a nonpatient population. J Prosthe Dent 1988 ; 59 : 228
71. Reider CE. The prevalence and magnitude of mandibular displacement in a survey population. J Prosthe Dent 1978 ; 39 : 324-9
72. Reynolds JM. Occlusal wear facets. J Prosthet Dent 1970 ; 20 : 367-72
73. Rosner D. A mathematic approximation of the angle of closure from retruded contact. J Periodontol 1973 ; 44 : 228-35
74. Russell MD, Grant AA. The relationship of occlusal wear to occlusal contact area. J Oral Rehabil 1983 ; 10 : 391
75. Roth RH. Funcional occlusion for the orthodontist : Part I. J Clinic Orthod 1981 ; 15 : 32-51
76. Seligman DA, pullinger AG, Solberg WK. The prevalence of dental attrition and diets effect of dental attrition and its association with factors of ages, gender, occlusal and TMJ Symptomatology. J Dent Res 1988 ; 67 : 1323-33
77. Shilkrout M, Wood DP, Hunter WS. The CR-CO discrepancy and its effect on cephalometric mesurements. Angle Orthod 1994 ; 64 : 333-42

78. Simon RL, Licholls JI. Variability of passively recorded centric relation. J Prosthe Dent 1980 ; 44 : 21-6
79. Simonet PF, Clayton MS. Influence of TMJ Dysfunction on Bennett movement as recorded by a modified pantograph, Part III : Progress report on the clinical study J Prosthe Dent 1981 ; 46 : 652-61
80. Slavicek R. Clinical and instrumental functional analysis for diagnosis and treatment planning Part 4 : Instrumental analysis of mandibular casts using the mandibular position indicator. J Clinic Orthod 1988 ; 22 : 566-75
81. Smith BGN, Knight JK. A Comparison of patterns of tooth wear with aetiological factors. Br Dent J 1984 ; 157 : 16-9
82. Song YB, Kim IK, Lee HY. A study on the changes of condylar positiion after use of the occlusal biteplane splint. J Korea Acade Prostho 1988 ; 26 : 171-83
83. Stuarts CE. Articulations of Human Teeth. Dental Items of Interest 1939 ; 61 : 1029
84. Ten Bruggen CHJ. Dental erosion in dentistry. Br J Ind Med 1968 ; 25 : 249-66
85. Tupac RG Clinical importance of Voluntary and induced Bennett movement. J Prosthe Dent 1978 ; 40 : 39-43
86. Weinberg LA. TMJ dysfunction and its effect on centric relation. J Prosthe Dent 1973 ; 30 : 176-95
87. Whittaker DK, Davies G, Brown M. Tooth loss, attrition and temporomandibular joint changes in a Romano-British population. J Oral Rehabil 1985 ; 12 : 407-19
88. Wise MD. Occlusion and restorative dentistry for the general practitiner. Br Dent J handbook 1986 : 62-5
89. Wise MD. Movement between centric relation contact position and the intercuspal position. Int J Prothod 1992 ; 5 : 333-44
90. Woda A, Gourdon AM, Faraj M. Occlusal contacts and tooth wear. J Prosthet Dent 1987 ; 57 : 85-93
91. Wood DP, Korne DH. Estimated and true hinge axis : a comparison of condylar displacements. Angle Orthod 1992 ; 62 : 167-75
92. Xhonga F. Bruxism and its effect on the teeth. J Oral Rehabil 1977 ; 4 : 65-76

사진부도 설명

Fig. 1. The SAM2 Articulator
Fig. 2. The Mandibular Position Indicator
Fig. 3. The example of small CRO-MI discrepancies
Fig. 4. The example of large CRO-MI discrepancies
Fig. 5. The split cast used for this study
Fig. 6. The measurement of CRO-MI discrepancies at slide blocks on the MPI

논문사진 부도

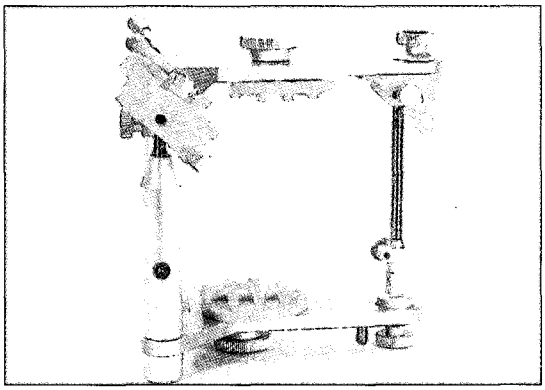

Fig. 1.

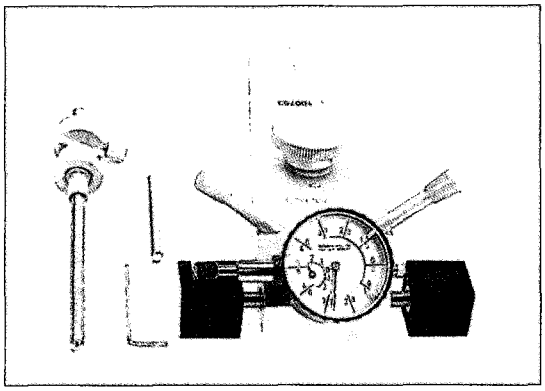

Fig. 2.

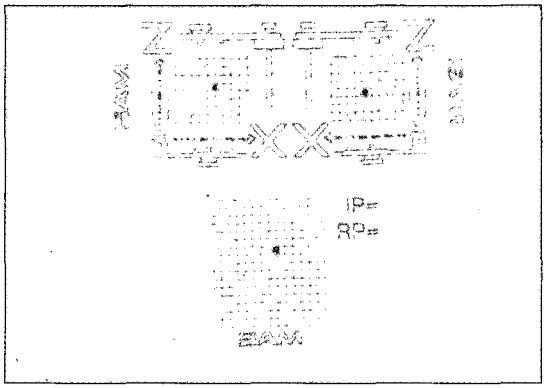

Fig. 3.

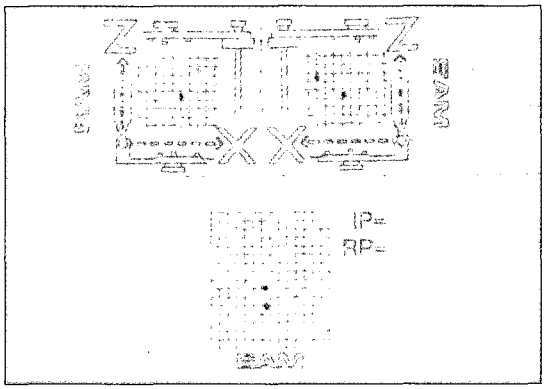

Fig. 4.

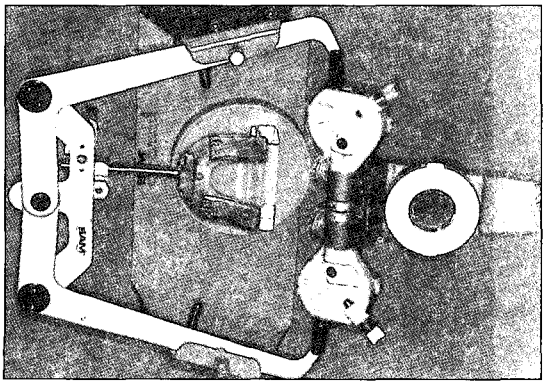

Fig. 5.

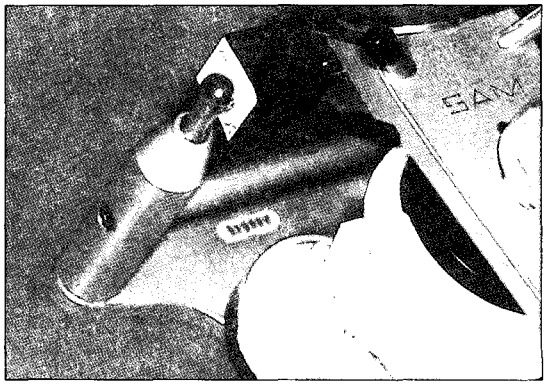

Fig. 6.

중심위 교합-최대교두감합위 불일치가 치아 마모에 미치는 영향에 관한 연구

서울대학교 치과대학 치과보철학교실

홍민아 · 김광남 · 허성주

치아경조직의 소실은 반드시 치아우식증이나 사고에 의해서만 일어나는 것이 아니라 마모에 의해서도 일어난다. 마모에 영향을 미치는 인자들은 시간/나이, 성별, 이갈이와 같은 과기능, 저작력, 위장관장애, 음식물, 환경적인 영향, 타액의 상태 그리고 교합적인 조건들이 있다. 한편 중심위와 최대교두감합위 불일치가 악구강계에 미치는 영향에 관해서는 아직도 논란이 분분하다. 본 연구의 목적은 중심위와 최대교두감합위의 불일치가 치아마모에 미치는 영향과 중심위에서 제일 먼저 닿는 치아와 나머지 치아의 마모에 있어서 차이에 대해서 알아 보는 것이다.

본 연구는 두개하악관절과 저작습관에 이상이 없으며, 식이습관에 문제가 없으며 치아우식증과 치주질환, 수복물,교정 또는 교합치료의 경험이 없는 21세에서 25세 사이의 서울대학교 치과대학생을 대상으로 하였다. 교합기를 이용하여 중심위 교합-최대교두교두감합위 불일치를 조사하여, 중심위 교합-최대교두감합위가 불일치가 작은 군과 큰 군으로 나누었다. 각 군은 각각 10명의 피검자들로 구성되었다. 각 피검자의 인상채득 후 CR mounting을 시행하고 중심위 교합-최대감합위 불일치를 측정한 다음 임상검사로 ordinal scale을 측정하고 모형을 통해 arbitrary scale을 측정하였다. 평균치아마모도 그리고 중심위에서 먼저 닿는 치아와 나머지 치아, 나머지 구치의 마모도를 각각 조사하여 통계처리하였다.

1. 평균치아마모도는 ordinal scale로 측정하였을 때 중심위 교합-최대교두감합위 불일치가 작은 군과 큰 군 사이에 통계적으로 유의할만한 차이가 없었다($p>0.05$).
2. 평균치아마모도는 arbitrary scale로 측정하였을 때 중심위 교합-최대교두감합위 불일치가 작은 군과 큰 군 사이에 통계적으로 유의할만한 차이가 없었다($p>0.05$).
3. CR에서 먼저 닿는 치아와 나머지 치아,나머지 구치의 마모도는 ordinal scale로 측정하였을 때 통계적으로 유의한 차이가 없었다($p>0.05$).
4. CR에서 먼저 닿는 치아와 나머지 치아,나머지 구치의 마모도는 arbitrary scale로 측정하였을 때 먼저 닿는 치아에서 통계적으로 유의한 높은 수준의 마모도를 보였다($p<0.05$).

중심어 : 중심위-최대교두감합위 불일치, 치아 마모, 먼저 닿는 치아