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CO-CR Comparison between Untreated & Treated CL II DIV 1 Cases

James W. Davis

Abstract

CO-CR COMPARISON OF UNTREATED &
TREATED CL II DIV 1 CASES

by
James W. Davis

The purpose of this retrospective study was to compare the CO-CR differences in pretreatment and posttreatment Cl II Div 1 patients. Similar sample groups were chosen from patients of the graduate orthodontic clinic at Loma Linda University School of Dentistry.

Each patient's models were mounted on a Sam II articulator using a face bow transfer and a centric relation check bite. The CO-CR discrepancies in the anterior-posterior, superior-inferior, and side-shift dimensions were determined with the Mandibular Position Indicator.

Using t-test analyses, statistically significant differences were found between the pretreatment and posttreatment groups, with the posttreatment sample exhibiting a smaller CO-CR discrepancy than the pretreatment sample.

LOMA LINDA UNIVERSITY

Graduate School

CO-CR COMPARISON BETWEEN UNTREATED & TREATED CL II DIV 1 CASES

by James W. Davis

A Thesis in Partial Fulfillment

of the Requirements for the Degree Master of Science

in Orthodontics

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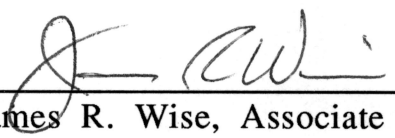
Each person whose signature appears below certifies that this thesis in his opinion is adequate, in scope and quality, as a thesis for the degree Master of Science.



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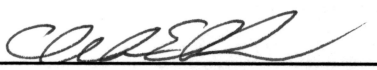

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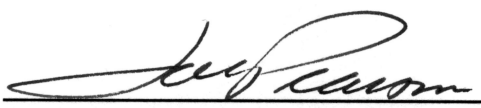

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INTRODUCTION

Modern orthodontics has as its ultimate goal the creation of a functional, esthetic, and stable occlusion that preserves the integrity of the temporomandibular joint. It has been suggested that malocclusion plays a major role in TMJ dysfunction.[1,2] Others contend that occlusion has an insignificant correlation with dysfunction.[3-6] Most investigators agree that an increased discrepancy between centric relation and centric occlusion is a predisposing factor to temporomandibular dysfunction.[7,8] An increase in the side shift of the condyle appears to be particularly damaging. This study compares the difference between pretreatment and posttreatment condylar positions in Cl II Div 1 malocclusions in an attempt to determine one of the possible effects upon the TMJ during orthodontic therapy.

REVIEW OF LITERATURE

All specialties of dentistry are dependent upon the centric relation position in order to establish an occlusal relationship that is harmonious with the temporomandibular joint. It is necessary to determine that the condyle is properly related to the disk complex and to the glenoid fossa before one can say that the occlusion is ideally functional.

A definition of the centric relation position has evolved over the years from a belief that it is merely the most retruded;[9] the rearmost, uppermost, midmost;[10] the most posterior position from which lateral movements can be made;[11] the most superior position the condyles can assume in the glenoid fossa;[12] to "the relationship of the mandible to the maxilla when the properly aligned condyle-disk assemblies are in the most superior position against the eminentia, irrespective of tooth position or vertical dimension."[13] Some have even considered a "long centric" to be proper where the mandible has the freedom to close in CR or in a position slightly anterior to CR without opening or closing the vertical occlusal dimension.[14-16] It has become necessary to describe the anatomical and functional dynamics of the TMJ in order to indicate the centric relation position. Centric occlusion has been less controversial to define, describing the relationship of the mandible to the maxilla at the point of maximum intercuspation of the teeth.[12]

The ideal relationship between CO and CR is thought to occur

when centric relation and centric occlusion are the same, and the condyles are symmetrically placed in their fossae. This only occurs, however, in 10-31% of the population.[17-19]

The methods of centric relation determination are almost as varied as the definitions. Also, just because a determination is reproducible, doesn't make it functional. Consequently, a determination has to be justifiable on the basis of the morphology and function of the joint.

Techniques of recording centric relation fall into two basic groups, radiographic and gnathometric, both of which are better at describing the relative positions of the condyles among different mandibular movements than the absolute positions for any one movement. Some investigators have shown that CR is superior and posterior to CO by comparing the joint spaces anterior, posterior, and superior to the condyle.[20] Others have described an average for each respective joint space.[21-24] Because of the variation in morphology of the condyle and fossa, and variations in condylar position, it is difficult to determine from the radiograph alone whether or not any condyle is exactly at the centric relation position.

Gnathometric methods, such as operator guided and muscle guided techniques seem to be more accurate in their determination. With practice, these techniques enable the operator to consistently arrive at a functional and reproducible centric relation position. The muscle guided methods were chosen for this study because of their ability to give a physiologic placement of the condyle.

MATERIALS & METHODS

The sample consisted of two different groups chosen from the patients at the Loma Linda University Orthodontic Clinic. From 315 patients accepted for routine orthodontic care, a pretreatment sample of 28 was chosen that met the following criteria: 1. Cl II Div 1, 2. full complement of permanent teeth (excluding third molars) as determined by radiographic examination, 3. no interproximal restorations or full coverage crowns, 4. no anterior or posterior open bite or crossbite, 5. overjet of 4-10 mm., and 6. unremarkable history of trauma, clicking or popping, locking, or pain to the TMJ. The posttreatment sample of 25 was screened from 364 patients that were treated with conventional edgewise therapy and had been debanded within 18 months of taking posttreatment records for this study. These met the same criteria for the pretreatment sample in addition to: 7. orthodontic correction with nonextraction treatment.

The following technique of determining the centric relation position was practiced until equal or nearly equal results could be duplicated on individual patients. Each step was completed while the patient was sitting erect in the dental chair.

Centric occlusion was registered by having the patients bite to a full intercuspal relationship on Moyco* beauty pink-medium dental

*Moyco Industries Inc., Philadelphia, Pa.

wax which had been softened in a warm water bath. Moyco wax was chosen because it becomes quite brittle at room temperature and not easily distorted during model orientation. After removal of the centric occlusion wax bite, the patient was instructed to bite down half hard for 2-5 minutes on cotton rolls placed on the occlusal surfaces of the right and left, upper and lower first molars. According to Wenneberg and Droukas this technique is effective in interrupting the proprioceptive feedback from the teeth which helps to deprogram the muscles of mastication.[3,4] It also tires the masseter and medial pterygoid muscles, thus minimizing their antagonistic influence during the centric relation determination. Delar* bite registration wax was softened for one minute in a 120 degrees F. water bath, folded to 4 thicknesses, and placed between the patient's incisors. The patient was then instructed to retrude the mandible, bite down slowly, and stop closing when the first posterior tooth contact was felt. This technique allowed the temporalis and superior fibers of the lateral pterygoid muscles to seat the condyles in the fossae. While the patient was holding this position, the anterior key was cooled with dry air. Another sheet of Moyco wax that had been precut to fit over the posterior teeth and softened in the water bath was placed interocclusally and the patient was instructed to bite again into the anterior key, thus registering the posterior teeth in the centric relation position.

*Almore International Inc., Portland, Or.

Maxillary and mandibular impressions were made using Cadco Adentic* fast set alginate impression material and immediately poured with orthodontic stone.

A face bow recording was taken with the SAM 2** anatomical face bow system using some green stick compound on the bite fork to register the occlusal tips of teeth in the right, left, and anterior regions. The shallow indentation of incisal tips in these three areas provided a stable tripod for accurate model orientation.

To minimize distortion of model orientation to the mounting plates due to the setting plaster, the final plaster pour was kept as thin as possible.

The models were related in centric relation on the Sam 2 articulator. Using the centric occlusion bite and the Mandibular Position Indicator,** the deviations in anterior-posterior, superior-inferior, and side shift directions were determined and recorded on the MPI labels.

In order to compare the difference between the centric relation determination using the power bite method and the leaf gauge method, 12 of the posttreatment patients also had a centric relation record taken using the leaf gauge method as described by Williamson.[25] The condylar position with this method was also determined and recorded using the MPI.

*Cadco Dental Products Inc., Portland, Or.

**Great Lakes Orthodontics, Tonawanda, N.Y.

RESULTS

A comparative study of pretreatment and posttreatment condylar positions in Cl II Div 1 malocclusions was undertaken in order to assess the effect that treatment mechanics may have on the centric occlusion-centric relation difference during routine orthodontic therapy.

The experimental group consisted of 52 patients at the graduate orthodontic clinic at Loma Linda University School of Dentistry. The data are summarized in Table 1. Because this was a retrospective study, it was necessary to determine that both experimental groups were similar with regards to age, sex, facial type, and overjet. The pretreatment sample had a total of 27 patients, 17 males and 10 females. The posttreatment sample consisted of 10 males and 15 females for a total of 25. There was no significant difference between the groups with regards to gender. (X^2=1.90, df=1)

The before-treatment ages for the pretreatment sample ranged from 120 to 184 months with the mean age equal to 152.30(20.38). For the posttreatment sample, the before treatment age was computed by subtracting the total treatment time plus the time since deband from the age at the time the data were collected. These ages ranged from 122 to 185 months with a mean of 154.64(19.18). Performing a t-test statistical analysis for age showed no difference with regards to age. (t=-.43)

For overjet, the range for the pretreatment sample was from 4 to 10 mm. with a mean of 6.15(1.7), and for the posttreatment sample, the before-treatment range was from 4 to 10 mm with a mean of 6.32(1.38). T test analysis yielded no difference with regards to overjet. (t=-.40)

Facial type was determined using three different methods. The first, published in "Bioprogressive Therapy",[26] examines the facial axis, facial angle, mandibular plane angle, the lower facial height, and the mandibular arc. Ricketts' method[27] substitutes total facial height for the mandibular arc. A third method,[28] similar to the first, substitutes cranial deflection angle for the facial angle, and weights the mandibular arc as 1.5 times the others in the determination. This last method put 3 of the 52 patients into the brachyfacial category that were in the mesofacial category using the other two methods. In these cases it was decided to make the mesofacial category the facial type of record. All three methods gave the same facial type determination in the other 49 patients. The pretreatment group consisted of 9 brachyfacial, 16 mesofacial, and 2 dolichofacial patients. The posttreatment group consisted of 10 brachyfacial, 12 mesofacial, and 3 dolichofacial patients. There was no statistically significant difference between the two groups with regards to facial type. (X^2=.75, df=2)

Since the statistical analyses for age, sex, facial type, and overjet showed no difference between the two sample groups, they were assumed to be the same with regards to these variables.

TABLE 1
Means, Standard Deviations, and t Values for each Sample

	Pretreatment	Posttreatment	Test Statistic
	n=25		
QUANTITATIVE			
Age	152.30 (20.38)*	154.64 (19.18)	t= -.43 df= 50
Overjet	6.15 (1.7)	6.32 (1.38)	t= -.40 df= 50
Treatment time		26.80 (11.93)	
Time since deband		8.60 (4.06)	
R x	-.52(1.21)	.06(.65)	t=-2.16 df=40 p=.036
R z	-.98(1.35)	-.38(.77)	t=-2.00 df=42 p=.053
L x	-.13(1.32)	-.08(.77)	t=-.16 df=50 p=.871
L z	-.91(1.27)	-.34(1.01)	t=-1.77 df=50 p=.082
Side shift	.55(.55)	.26(.34)	t=2.33 df=44 p=.024
QUALITATIVE			
Facial Type			X^2= .75 df=2
Brachyfacial	9	10	
Mesofacial	16	12	
Dolichofacial	2	3	
Sex			X^2 = 1.90 df=1
Male	17	10	
Female	10	15	
Headgear/Elastics			
HG & E		15	
E only		10	

*Mean(SD)

The mean treatment time for the posttreatment sample was 26.80(11.93) months, with a range from 13 to 71 months. The mean time since deband for the posttreatment group was 8.60(4.06) months, and the range was from 2 to 19 months. The Cl II correction was accomplished with the use of headgear and elastics for 15 patients, and elastics only for 10.

Due to the fact that the models were mounted in the centric relation position, all of the measurements given in Table 1 for condylar position show the amount and direction of change from

centric relation to centric occlusion. R x and L x indicate the right and left condylar change in the anterior-posterior dimension, and R z and L z indicate the right and left condylar change in the superior-inferior dimension. SS signifies side-shift without regard to whether it was to the right or left.

The positive and negative values represent the direction of shift. The (+) values were anterior or superior in direction, and the (-) values were posterior or inferior in direction.

The mean R x value for the pretreatment sample was -.52(1.21), and for the posttreatment sample was .06(.65). T-test results showed a statistically significant condylar position change between the two groups with the posttreatment position being more anterior on the right side. (t= -2.16, df=40, p=.036) The R z value for the pretreatment sample was -.99(1.35), and for the posttreatment sample was -.38(.77). This is a change of borderline significance and shows an average condylar position change in the superior direction on the right side from pretreatment to posttreatment. (t=-2.00, df=42, p=.053)

A scattergram representation of pretreatment (Fig. 1) and posttreatment (Fig. 2) condylar positions for the right side allows a two dimensional view of the condylar position change between centric relation and centric occlusion for the sample patients. Since the models were mounted in centric relation (coordinates 0,0), the scatter points indicate the relationship between centric occlusion and centric relation positions for each sample.

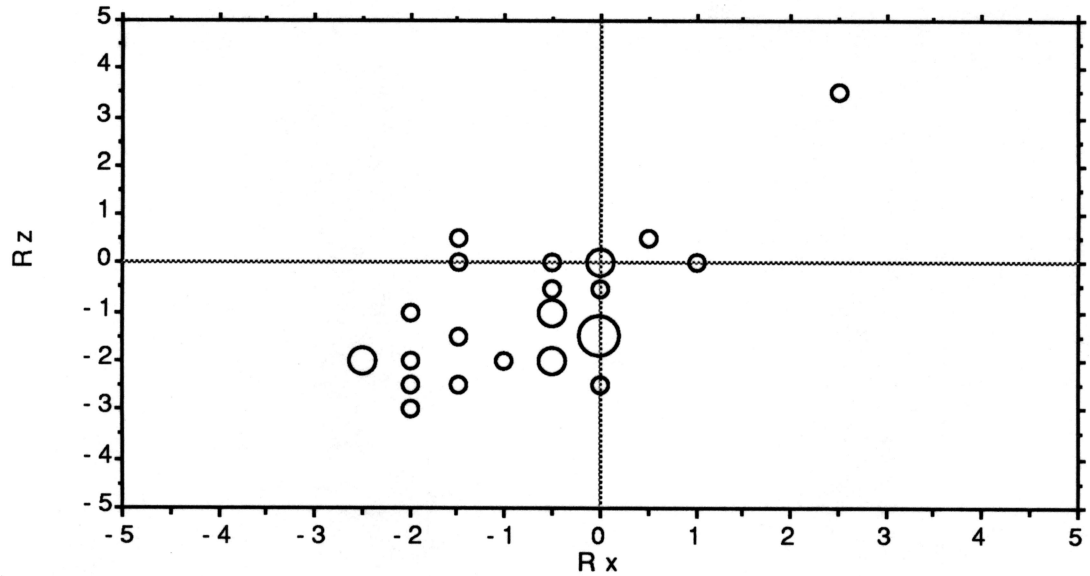

Fig. 1. Pretreatment right condyle.
*Overlapping points are indicated by geometrically enlarged points with enlargement size based on the number of points that coincide at that location.

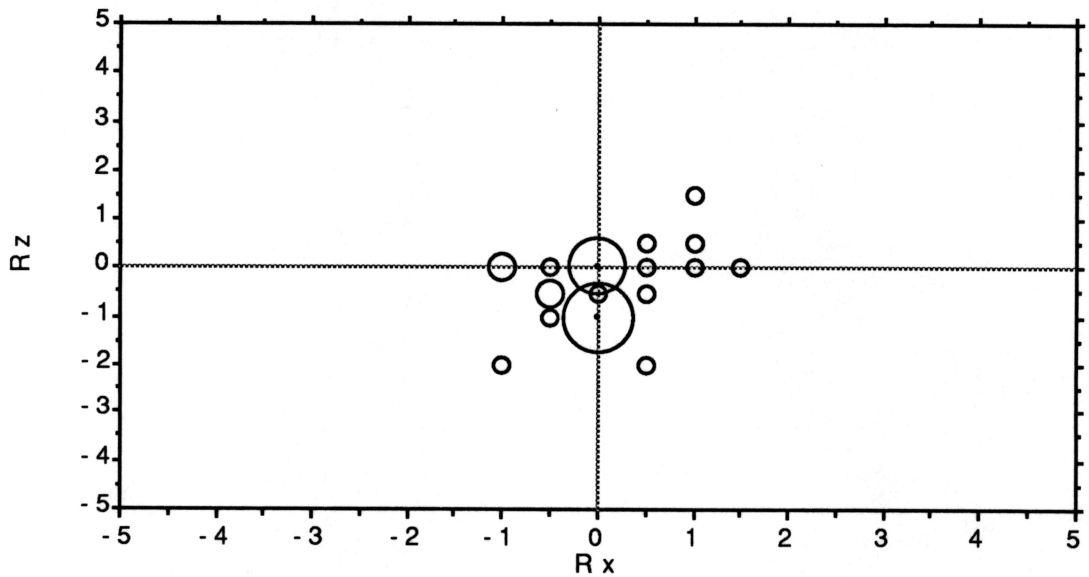

Fig. 2. Posttreatment right condyle.

The mean L x value for the pretreatment sample was -.13(1.32), and -.08(.77) for the posttreatment sample. The difference was not significant in the anterior-posterior direction. (t=-.17, df=42, p=.87) For the L z values the mean for the pretreatment group was -.91(1.27), and for the posttreatment group was -.34(1.01). The difference between the two samples was not statistically significant in the superior-inferior direction. (t=-1.77, df=50, p=.082) The average condylar position change on the left side from pretreatment to posttreatment was in an anterior and superior direction.

The left side condylar position changes between centric relation and centric occlusion for pretreatment (Fig. 3) and posttreatment (Fig. 4), are also represented on scattergrams.

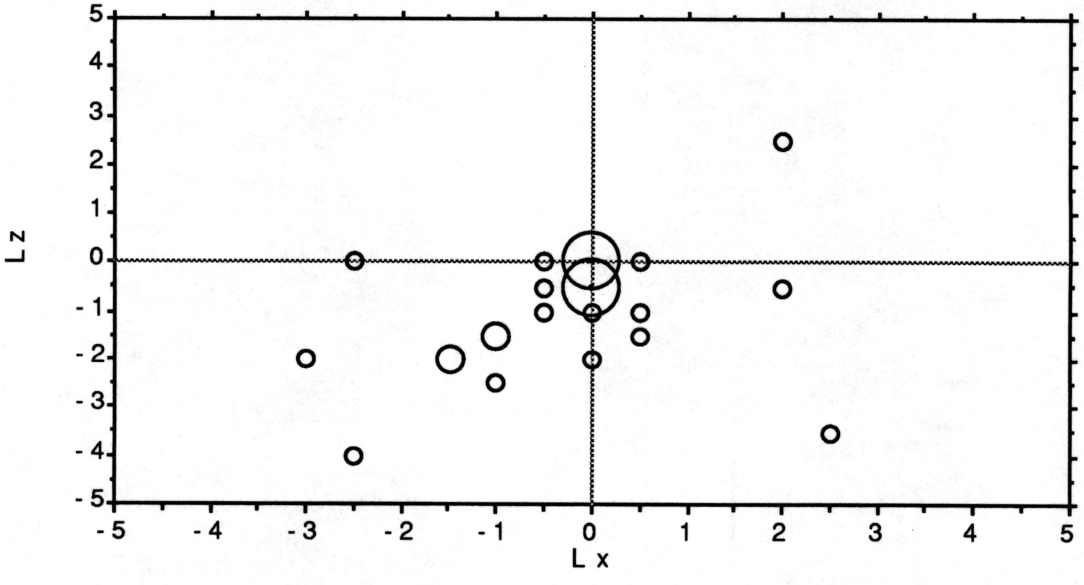

Fig. 3 Pretreatment left condyle.

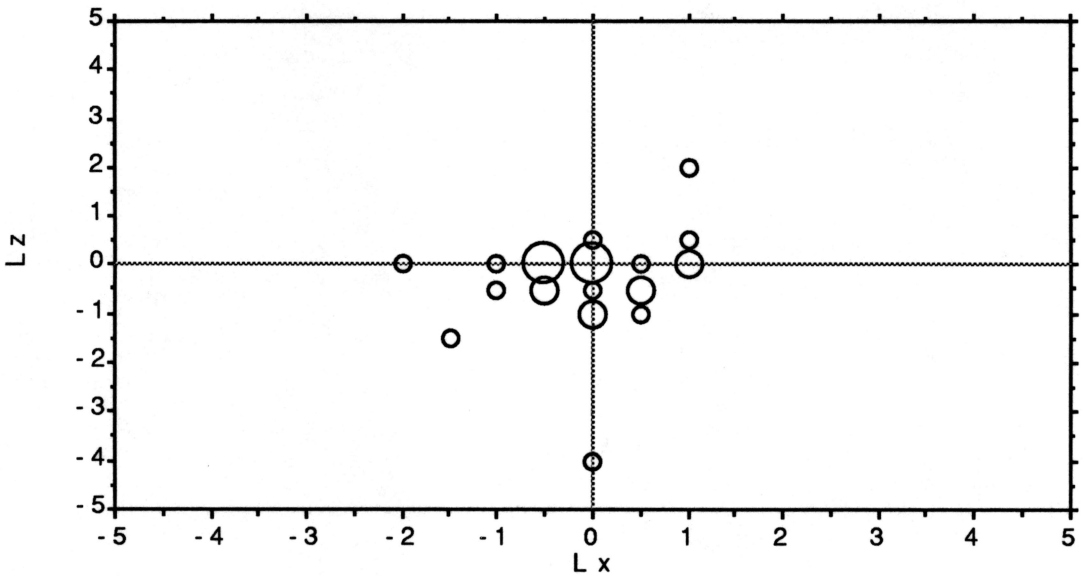

Fig. 4. Posttreatment left condyle.

For sideshift the mean values for the pretreatment sample was .55(.55), and .26(.34) for the posttreatment sample. T test analysis showed a statistically smaller amount of side shift in the posttreatment sample. (t=2.33, df=44, p=.024)

For twelve patients in the posttreatment sample, the centric relation determinations between the power bite method and the leaf gauge method were compared. With the power bite CR as the standard (coordinate 0,0), the leaf gauge CR was recorded and measured using the mandibular position indicator. The mean and statistical analysis values can be found in Table 2.

TABLE 2
Means, Standard Deviations, and t Values of Leaf Gauge Centric Relation Vs. Power Bite Centric Relation

	Mean(S.D.)	Test statistic
LG R x*	-.54(.45)	t=-4.17 df=11 p=.002
LG R z	.46(.69)	t=2.30 df=11 p=.042
LG L x	-.42(.56)	t=-2.59 df=11 p=.025
LG L z	.42(.56)	t=2.59 df=11 p=.025
SS	.23(.19)	t=-2.18 df=11 p=.052
LG SS	.35(.25)	

*LG indicates leaf gauge

Even though the sample size was small, a t-test statistical analysis was performed to see if there was a difference between the two methods. On the right side, the deviation with the leaf gauge was posterior and/or superior in each case except one (see Fig. 5). LGR x had a mean value of -.54mm(.45) and LGR z had a mean value of .46mm(.69) The difference on the right side between leaf gauge CR and power bite CR was statistically significant in the anterior-posterior (t=-4.17,df=11,p=.002) and superior-inferior (t=2.30, df=d11, p=.042) dimensions with the leaf gauge CR generally located posterior and superior to the power bite CR.

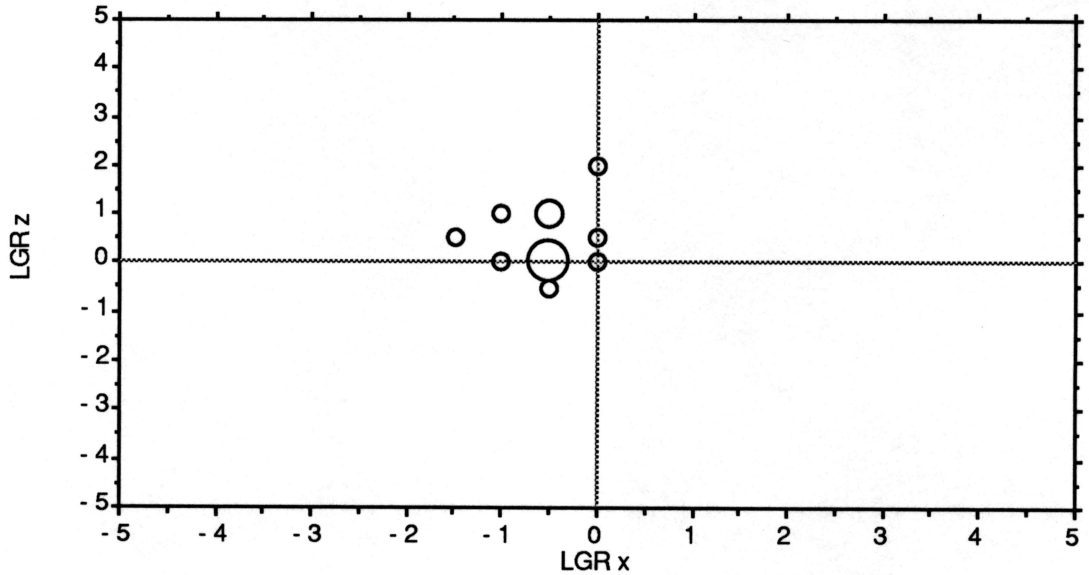

Fig. 5. Posttreatment right condyle. Leaf gauge vs. power bite. *Coordinates for power bite CR are 0,0.

With the exception of one case, the left side also showed a leaf gauge deviation in a superior and/or posterior direction (see Fig. 6). The mean LGL x value was -.42mm(.56) and the LGL z mean was .42mm(.56). The difference with the leaf gauge on the left side was also statistically significant in a posterior (t=-2.59,df=11, p=.025) and superior (t=2.59, df=11, p=.025) direction.

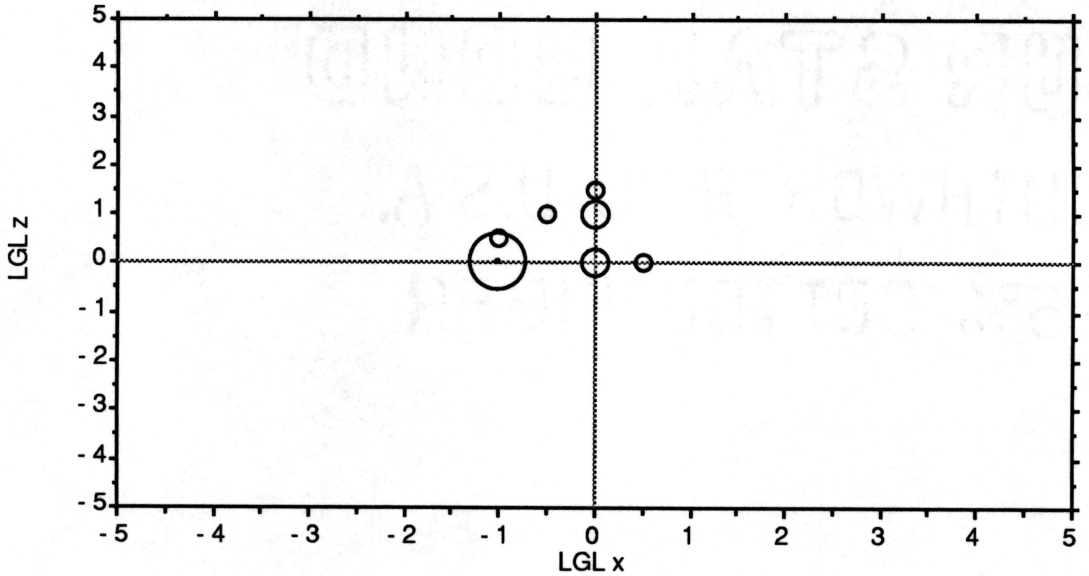

Fig. 6. Posttreatment left condyle. Leaf gauge vs. power bite.

The side shift for the twelve posttreatment sample patients had a mean value of .23mm(.19) with the power bite CR. For the leaf gauge CR, the side shift mean value was .35mm(.25). The t-test analysis showed a difference of borderline significance, with the leaf gauge value about one-tenth of a millimeter greater than the power bite. (t=-.218, df=11, p=.052)

DISCUSSION

Even though centric relation and centric occlusion do not coincide in the average healthy human dentition, it is the opinion of Williamson[7], Dawson[8], and others that cases should be finished as close to CR as possible.

This comparative study of condylar positions in similar pretreatment and posttreatment sample groups showed a decrease in the CO-CR discrepancy after routine orthodontic therapy. The posttreatment condylar position in centric occlusion was, on average, more superior and anterior than the pretreatment condylar position, and closer to centric relation.

In view of the suggestion that the use of Cl II elastics could cause undue stress on the temporomandibular joint, it was hoped that this project would not reveal a harmful effect upon the CO-CR discrepancy in Cl II correction. The data from this study indicate that the C0-CR discrepancy actually decreased after Cl II correction in the Cl II Div 1 sample population.

The most obvious reason for this superior and anterior seating of the condyle would be the correction of the malocclusion. It was determined by this study that after orthodontic therapy, centric relation and centric occlusion were more coincident than before treatment. Remodeling of the condyle,[29,30] and remodeling of the glenoid fossa,[30,31] have been reported in nonhuman studies using anterior repositioning functional appliances but have not been

documented in humans so neither is thought to be a very likely source of the decrease in CO-CR discrepancy. Condylar growth[30,32] could have been a contributory factor in the brachyfacial patients but the superior-anterior positioning would not be typical of mesofacial or dolichofacial patients.

The fact that CO-CR side shift decreased from pretreatment to posttreatment would be expected since the shift in condylar position decreased.

Even though there was a very small sample (n=12), the comparison between power bite CR and leaf gauge CR revealed statistically significant results. With only one exception, the condylar position with the leaf gauge was superior and posterior to that achieved with the power bite. This conflicts somewhat with the results found by Williamson where the "bite easy" position with the leaf gauge showed no significant difference from the wax record in the superior-inferior dimension; and the "bite hard" position with the leaf gauge was significantly more posterior than either the wax bite or the "bite easy" position.[33] While extreme care was taken to have the patients gently bite on the leaf gauge, it is certainly possible that they were biting with a greater force than was necessary which could account for the superior-posterior deflection. Another possibility, however, is that by having the patients bite on the leaf gauge for several minutes, the muscles were allowed to relax and the condyle was being seated further in the fossa than possible with the wax power bite. The resistance of the wax bite does not allow for a

continous force of several minutes duration without a decrease in vertical dimension and eventual contact of the posterior teeth.

Since the difference between CO & CR increased with the use of the leaf gauge vs. the power bite, it follows that the magnitude of the side shift could also increase, which was the case in this study.

A longitudinal study, following the same sample from pretreatment to posttreatment and retention, without having to rely on the assumptions of similar groups, could possibly yield more significant findings on this question. The evidence from this study does suggest however, that Cl II correction does not have an adverse effect on the CO-CR discrepancy.

SUMMARY

A retrospective comparison of pretreatment and posttreatment Cl II Div 1 condylar positions was made using the Sam II system and the mandibular position indicator with articulator mounted casts. Centric occlusion and power bite centric relation records were taken on all patients in order to determine the CO-CR discrepancies. Leaf gauge centric relation records were taken on twelve of the posttreatment patients to compare these two methods of CR determination.

The data from this study indicate that the CO-CR discrepancy decreased significantly after orthodontic correction of the Cl II Div 1 malocclusion. The posttreatment condylar position in centric occlusion was generally more superior and anterior than the pretreatment condylar position, and the side-shift also decreased. The leaf gauge centric relation was superior and posterior to the power bite centric relation.

A longitudinal study of a particular treatment group could produce more significant results, but one can conclude from this study of similar groups that orthodontic correction of a Cl II Div 1 malocclusion decreases the CO-CR discrepancy.

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