The CR-CO discrepancy and its effect on cephalometric measurements

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The importance of centric relation has been debated for many years. Dawson[1] described centric relation as a maxillo-mandibular relationship in which the properly aligned condyle and disc are in the most superior position in contact with the posterior surface of the articular eminence, irrespective of vertical dimension or tooth position. Lucia[2] believes that the correct centric relation is essential for coordination of the occluding tooth surfaces and the temporomandibular joint.

The dental literature contains as few as two studies directly addressing the matter of centric relation and cephalometrics. Wood[3] studied "centrically related cephalometrics" with a sample of 30 patients whose casts were mounted on a Whip-mix articulator (using face-bow and centric bite). His "shadowgraph technique" permitted the comparison between centric occlusion and centric relation. Limitations due to the radiographic enlargement factor allowed the measurement of only a small number of cephalometric angles. Wood stated that "although the statistical analysis suggests the accuracy of the shadowgraph, it by no means renders the technique clinically applicable". He did, however, conclude that mounted casts and "centrically related cephalometrics" offer more accurate

Abstract

The purpose of the present study was to compare cephalometric measurements derived from a centric occlusion (CO) tracing with those of a converted centric relation (CR) tracing. The sample consisted of 68 consecutively treated patients, with a CR-CO discrepancy of 2 mm or greater in either the horizontal and/or vertical planes, measured at the condyles from mounted models. Comparisons were also made within the sample between the 39 females and 29 males; and the 35 skeletal Class I and 33 Class II patients.

In analyzing the CR-CO discrepancy, the vertical component was greater than the horizontal in 96% of the sample. Every patient had a vertical component, although 10% had no horizontal component. Correlations between the horizontal discrepancy and the two tracings showed high values for approximately 50% of the measures, whereas little correlation was found with the vertical discrepancy.

Paired t tests used to compare the CO and CR cephalometric values demonstrated significant differences ($p<0.05$) for the majority of the values studied. However, there generally were no differences between the groups of males and females, or between the skeletal Class I and Class II individuals. The results of this study suggest that to make a correct orthodontic diagnosis the mandible should be placed in centric relation rather than in the more traditional centric occlusion.

Key Words

CR-CO discrepancy • Converted ceph • Centric relation

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Table I
Description of CR-CO conversion (originated by Slavicek and modified by Corbett and Williams)

1. On a CO tracing, draw Frankfort Horizontal (FH) and functional occlusal plane (FOP).
2. Draw the axis-orbital plane (AOP) as a line 6.5 degrees from FH through orbitale extending through the neck of the condyle.
3. Record the vertical overbite by drawing a short line parallel to the FOP extending through the incisal edge of the lower incisor.
4. Locate and mark the estimated hinge axis point (HAP) on the CO tracing as 2/3 the width of the condyle forward from its posterior aspect on the AOP.
5. Plot the Δx and Δz MPI readings on a graph sheet, as shown in Figure 3.
6. Overlay the CO tracing on the graph sheet registering at the estimated HAP at the crosshair and superimposed on the AOP (large horizontal line on graph sheet).
7. Mark a new CR HAP on the CO tracing from the graph sheet.
8. Using a new piece of tracing paper placed on the CO tracing draw the mandible, lower teeth, vertical overbite line, lower lip and chin soft tissue, and HAP.
9. Superimpose the HAP of the new tracing on the CR HAP of the first tracing and rotate on this point to the best superimposition of vertical overbite line.
10. Trace the maxilla, upper teeth and remaining landmarks to make a centric relation tracing (Figure 4 shows the difference in mandibular position between a CO [solid line] and CR [broken line] tracing as one is superimposed over the other).

information than hand-articulated casts.

Wood used the term "dynamic occlusion" which differentiates tooth-directed centric occlusion from centric relation dictated by the joints and ligaments.

Williamson et al.[4] used the "centric-ceph" technique on a sample of 46 patients divided into groups of Angle Class I and Angle Class II cases. They concluded that there were differences in cephalometric measurements with respect to the mandibular position, though most differences were slight. They found that Class II patients exhibited the largest discrepancies.

The role of occlusion in orthodontics has been studied by many authors. Aubrey[5] observed that to finish a case in centric relation it is essential to remove functional interferences. Therefore he stated that one must "adapt teeth to joints and not ask the joints to adapt to the teeth". Roth has been advocating the need to treat patients in centric relation since the 1970s.[6-8] He believes that there is a relationship between temporomandibular pain-dysfunction and occlusal interferences[6] and has described the criteria necessary to achieve functional occlusion.[7]

Timm et al.[9] observed that "... a common error is to accept a tooth arrangement that is Class I in centric occlusion but is actually Class II when the mandible is in centric relation". Therefore it is important to make a diagnosis from mounted casts in centric relation to correct the "true" and not the apparent malocclusion.

However, it is seldom possible to have a headfilm in CR when planning treatment. To circumvent this problem, Slavicek[10,11] developed a technique permitting the transfer of information obtained from mounted casts, which allows the transformation of a CO tracing into a CR tracing. Slavicek's approach was later modified by Maurice C. Corbett (Carmel Valley, Calif.) and modified again by Robert E. Williams (Mountain View, Calif.). The modified Slavicek approach has made possible an accurate evaluation of a malocclusion in centric relation.

The purpose of the study was to determine if there was a significant difference between 24 cephalometric measurements of mandibular position derived from a centric occlusion (CO) tracing compared to those of a converted centric relation (CR) tracing. If statistically significant differences exist between CR and CO, this could affect the diagnosis and treatment planning necessary to correct the malocclusion.

Materials and methods

Sample

Diagnostic records from a sample of 131 consecutively treated patients (none of whom had TMD symptoms pretreatment) were collected from the private practice of one orthodontist in London, Ontario. The records included an initial lateral cephalogram and all diagnostic casts mounted by the same clinician on the same SAM2 (Great Lakes Orthodontics, Buffalo, New York) articulator using an estimated face-bow[12] and centric relation bite registration. The methodology for taking the centric relation bite registration was the same as outlined in Appendix I by Wood et al.[13] The amount of condylar distraction present was recorded using a mandibular position indicator (MPI)[11,12] and a centric occlusion wax bite registration. The MPI is an instrument that allows the clinician or researcher to evaluate the magnitude and directional displacement that occurs in the condylar axis from CR to CO. The nature of the slide at the level of the occlusion most often does not necessarily reflect the condylar movement. The MPI is a modified upper member of the SAM2 articulator in which the condylar housings have been replaced with laterally sliding cubes that contact the medial poles of the condylar elements (balls) when related to the lower member of the articulator. A right and left adhesive paper that has a 1 mm square grid is placed on the outside of each sliding cube of the MPI. In the center of each cube is an internal pin that perforates the grid paper and thereby marks CR the condylar axis. Once the grid papers have been fixed to the sliding cubes and perforated, the maxillary cast is attached to the MPI. The CO wax bite registration as described by Wood and Korne[12] is then placed on the upper cast. The lower cast that is fixed to the lower member of the articulator is then placed firmly into the CO wax. The CO wax allows the approximation of the models into maximum intercuspation (plaster to plaster contact) and yet prevents rocking. The incisal guide pin of the MPI is then dropped onto the incisal table of the lower member of the articulator to further stabilize things. To record the condylar axis position in CO, articulating paper is held against the sliding cubes (with the graph paper affixed). The cubes are then slid out laterally to contact the condylar elements (balls) of the lower member of the articulator thereby marking the paper. The difference between the perforation by the pin on the graph paper (CR position) and the mark of the articulating paper (CO position) is recorded in units of half millimeters in the horizontal (X) and vertical (Z) planes. For the horizontal (X) plane, when the CO mark is posterior to the CR perforation, the value is recorded as negative and when anterior the value is positive. For the vertical (Z) plane, when the CO mark is inferior the value is recorded as positive. By definition condylar position is always superior in CR. Therefore the articulator mark (CO) should always be inferior to the perforation (CR) if the patient has no TMJ symptoms, the casts have been mounted correctly and the CR bite has been taken correctly.

Any patients who did not have a CR-CO discrepancy (averaged between right and left sides) of 2 mm or greater in either the horizontal (Δx) and/or vertical (Δz) sagittal planes were eliminated. The resulting sample size for study was 68 patients (or 52% of the consecutively treated sample). The adolescents (64 patients) ranged from 9 to 17 years with a mean age of 12.8 years. The adults (4 patients) ranged from 19 to 35 years with a mean age of 27 years. An analysis of the Δx or Δz values showed that 55% of the study sample had a value between 2 mm and 3 mm, 38% had a value between 3 mm and 4 mm, and 7% had a value of 4 mm or greater. A graphic representation of the averaged MPI recordings is shown in Figure 1.

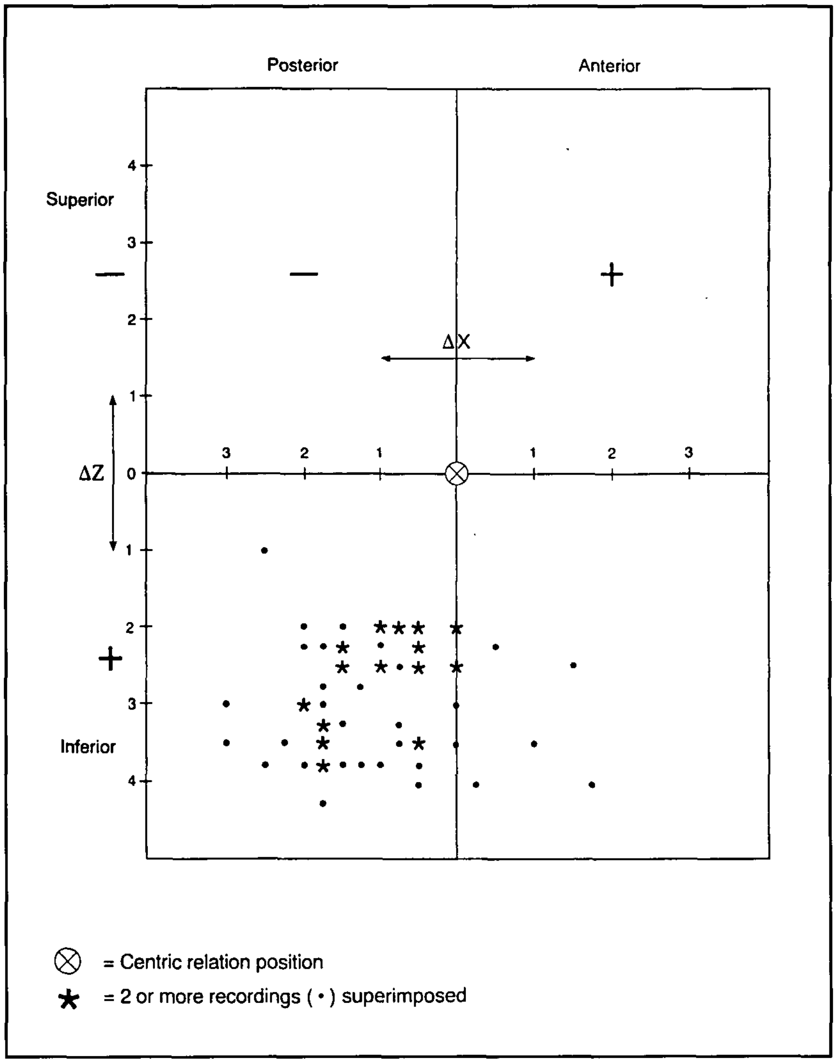

Figure 1

Figure 1
Graphic representation of averaged MPI recordings (n=68)

For comparison, the sample of 68 was divided into groups of skeletal Class I and skeletal Class II cases. Any case with an ANB angle of ≥4 degrees was considered Class II. This resulted in 35 Class I cases and 33 Class II cases. For the determination of sex differences, comparisons were made between the 39 females and 29 males.

All initial films were traced on frosted acetate and subsequently digitized on a digitizing board. Landmarks, as shown in Figure 2, such as Sella, Nasion, A and B point, Pogonion, Gnathion, Menton and Gonion, were located on each tracing prior to digitizing. The Orthodontic Treatment Planning (OTP) program (Computer Diagnostics Information Inc., Burlingame, Calif) was used to calculate the various skeletal and dental measures described in Figure 2. Only mea-

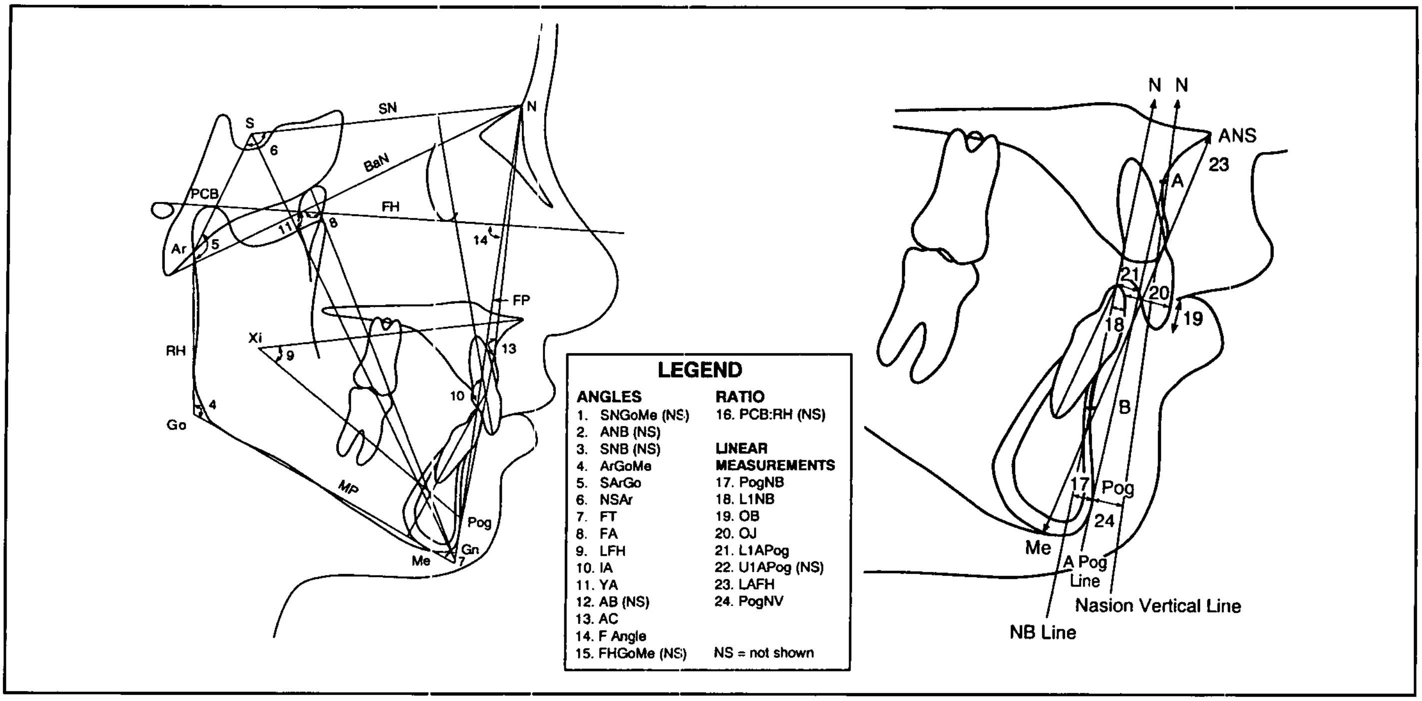

Figure 2

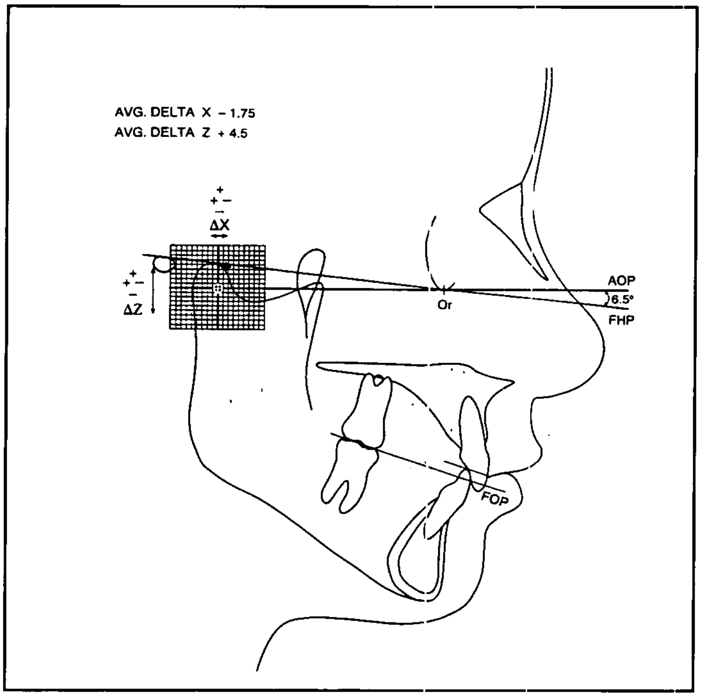

Figure 3

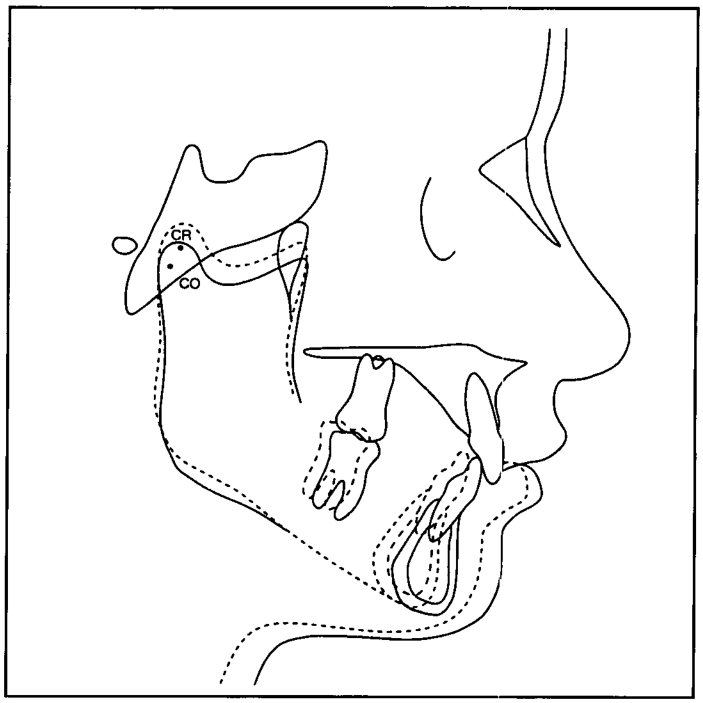

Figure 4

Figure 2
Cephalometric landmarks used: angles and ratios (left) and linear measurements (right). FT=facial taper; FA=facial axis; IA= interincisal angle; YA= Y axis; AB=AB plane; AC=angle of convexity; F Angle= facial angle.

Figure 3
CO tracing on grid for conversion. AOP=Axis orbital plane; FHP=Frankfort horizontal plane; FOP=Functional occlusal plane; HAP=Hinge axis point; ⊕=CR-HAP; ⊖=CO-HAP.

Figure 4
CO and CR tracings superimposed
CO———; CR- - - - - - - - -

sures of mandibular position were chosen for the purpose of this study. The accurate conversion of the CO cephalogram to CR using the patient's MPI readings, as described in Table I, was performed by OTP. The OTP program incorporates the last modified method by Williams, that is, there is a direct repositioning of the estimated facebow axis (or true axis if one is located) at the condylar level, but the vertical overbite of the incisors remains the same as it was in CO. When the mandible is autorotated closed to the original overbite, the vertical opening of the mandible due to the CR-CO discrepancy is eliminated. The closing to the original overbite allows one to measure only the effect that the CR position has on the subjects anteroposterior jaw relationship when compared to the CO position. The conversion averages right and left sides to produce a simulation of the effect at midsagittal. It is important to understand that the vertical opening of the mandible due to occlusal interferences must be eliminated with this modified conversion technique to evaluate the true anteroposterior jaw relationship discrepancy. The vertical opening caused by the interferences must be evaluated on the articulated models themselves to determine the actual amount of vertical and/or transverse discrepancy.

For the so-called "centric slide" from CR to CO, the condyle generally shifts downward and backward. To convert the CO headfilm from CO to CR the condyle moves upward and forward. Therefore, the CR hinge axis point should always be in the upper right quadrant of the grid (refer to Figure 3). Figure 4 shows graphically a CO and CR tracing superimposed on fixed landmarks. The cephalometric measurements in question were calculated on the CO tracing and subsequently on the CR tracing constructed by OTP.

Statistical analysis

Paired t tests were used to test for differences between the CO and CR cephalometric measurements for: 1) the full sample; 2) skeletal Class I and Class IIs; and 3) males and females. Statistical significance was set at the 0.05 level.

It was hypothesized that correlations between the horizontal component (Δx) and the CR-CO differences would be higher than the same correlations for the vertical component (Δz). Pearson's correlations were calculated between $\Delta x/\Delta z$ and the CR-CO differences for each of the cephalometric measurements.

Measurement error

For the purposes of determining the standard error of measurement, 10 CO cephalograms were chosen at random. They were traced twice and each one was then digitized. The method error was then calculated according to the following formula:

Standard Error:

$$SE = \sqrt{\frac{\sum d^2}{2n}}$$

where Σd^2 is the sum of the squared differences between the two cephalometric measurements of the CO tracing, and n represents the sample size.

Table II
A comparison between CO and CR measures with means and standard deviations (n=68).

Measure	CO Mean	CO SD	CR Mean	CR SD	Dif.btw. means	P
PCB:RH	72.3	11.9	67.0	9.7	5.3	<0.001
SNGoMe	33.7	6.7	35.6	6.9	1.9	<0.001
ANB	4.1	2.0	4.9	2.4	0.8	<0.001
SNB	77.2	3.7	76.3	3.7	0.9	<0.001
ArGoMe	65.1	7.3	63.8	5.2	1.3	0.031
SArGo	144.0	5.7	144.0	7.0	0	0.975ns
NSAr	125.0	5.5	126.2	5.3	1.2	0.001
FT	68.0	5.3	67.1	5.4	1.1	<0.001
FA	87.8	4.4	86.6	4.6	1.2	<0.001
LFH	48.9	5.0	49.0	5.0	0.1	<0.001
IA	126.6	10.9	124.7	10.9	1.9	<0.001
YA	68.5	4.0	69.3	4.1	0.8	<0.001
FHGoMe	26.0	6.4	27.9	6.5	1.9	<0.001
AB	4.1	2.0	4.9	2.3	0.8	<0.001
AC	3.2	1.9	4.0	2.3	0.8	<0.001
FAngle	87.3	4.1	86.0	4.2	1.3	0.036
PogNB	2.1	1.7	1.9	1.6	0.2	<0.001
L1NB	5.3	2.6	5.7	2.6	0.4	<0.001
OB	3.8	1.8	3.8	1.8	0	
OJ	5.2	3.0	6.0	3.5	0.8	<0.001
L1APog	1.9	2.6	1.8	2.7	0.1	<0.001
PogNV	-8.1	5.6	-9.9	5.8	1.8	<0.001
LAFH	70.0	7.0	70.5	6.8	0.5	0.087ns
U1APog	7.6	3.5	8.5	3.8	0.9	<0.001

The OTP program is said to record horizontal and vertical positions to within +/-0.01 mm accuracy.

Results

A description of the various cephalometric measures and the comparison between CO and CR, as seen in the full sample, can be found in Table II. The results show that 21 out of 24 differences were found to be statistically significant. Angles such as: SNGoMe, ANB, SNB, FT, FA, NSAr, LFH, PogNV, IA, YA, FHGoMe, AB and AC displayed a high degree of significance ($p<0.001$). Others were also found to be statistically significant, ArGoMe ($p=0.031$) and FAngle ($p=0.036$), but to a lesser extent. Certain linear values were highly significant; PogNB, L1NB, OJ, L1APog, and U1APog as well as the PCB:RH ratio ($p<0.001$). Three of the measurements studied were not significant: SArGo ($p=0.975$), LAFH ($p=0.087$) and OB.

A comparison of the differences between the

Table III
Comparison of differences between the means for Class I and Class II subjects.

	Measure	Class I (n = 33) Diff. btw. Means	Class II (n = 35) Diff. btw. Means
Ratio	PCB:RH	6.1*	4.9***
Angles	SNGoMe	1.9*	1.9*
	ANB	0.6*	1.1*
	SNB	0.7*	1.1*
	ArGoMe	2.0*	0.7ns
	SArGo	0.9**	0.1ns
	NSAr	1.0**	1.9*
	FT	1.1*	0.8*
	FA	1.0*	1.2*
	LFH	0.2*	0.1*
	IA	1.9*	1.9*
	YA	0.8*	0.7*
	FHGoMe	2.0*	1.9*
	AB	0.6*	1.1*
	AC	0.6*	1.1*
	FAngle	4.6ns	0.9ns
Linear	PogNB	0.3*	0.2*
	L1NB	0.5*	0.5*
	OJ	0.6*	1.1*
	L1APog	0.3ns	1.5*
	PogNV	1.7*	1.5*
	LAFH	0.7ns	0.3*
	U1APog	0.7*	1.1*

* $p<0.001$
** $p<0.01$
*** $p<0.05$

Table IV
Comparison of differences between the means for male and female subjects.

	Measure	Males (n = 29) Diff. btw. Means	Females (n = 39) Diff. btw. Means
Ratio	PCB:RH	7.5*	3.8***
Angles	SNGoMe	2.0*	1.8*
	ANB	0.8*	0.8*
	SNB	0.9*	0.8*
	ArGoMe	0.7ns	1.8*
	SArGo	0.6ns	0.4ns
	NSAr	1.4*	1.4*
	FT	1.0*	0.8*
	FA	1.0*	1.0*
	LFH	0.2*	0.1*
	IA	2.0*	1.8*
	YA	0.9*	0.8*
	FHGoMe	2.1*	3.4*
	AB	0.8*	0.8*
	AC	0.8*	0.9*
	FAngle	0.6ns	1.7***
Linear	PogNB	0.2*	0.2*
	L1NB	0.4*	0.3*
	OJ	0.9*	0.7*
	L1APog	0.0ns	0.1ns
	PogNV	2.0*	1.8*
	LAFH	0.9ns	0.3*
	U1APog	0.9*	0.8*

* $p<0.001$
** $p<0.01$
*** $p<0.05$

means for the skeletal Class I and Class II cases is shown in Table III. In general, the differences between the two groups were minimal. Only 6 out of 20 cephalometric measures differed somewhat when compared to the other measures. The difference in PCB:RH was high and each value was statistically significant. The FAngle difference varied greatly between the Class I and Class II individuals but neither value was statistically significant. Even though there was a trend for the Class II differences to be greater than the Class I, generally there was no difference between these two groups.

Table IV lists the differences between the means when comparing males and females. Four out of 17 cephalometric measurements differed to a certain extent when compared to the other measurements. Once again PCB:RH showed a high difference between males and females, with each value statistically significant. In general, though, the values observed differed mildly from one group to the other. Therefore, there did not appear to be any sex differences.

Table V lists the correlation coefficients for the size of the horizontal (Δx) and vertical (Δz) components and the CR-CO differences. For this sample, with an n of 68 the r needed to be ≥.390, ≥.310 and ≥.239 to reach a level of significance of 0.001, 0.01 and 0.05 respectively. There was a significantly high correlation (0.001 level) between the size of the horizontal discrepancy (Δx) and the size of the CR-CO difference for 12 out of 23 measures. However, only 2 out of 23 measures had a significantly high correlation (0.001 level) for the vertical discrepancy (Δz).

The results of the error study are found in Table VI. The standard error values were within acceptable limits except for three. The standard error for PCB:RH was 3.75, for SArGo it was 2.48, and 2.94 for FA. These numbers are considered high, but this would only be of concern if the p values for these measurements were merely approach-

Table V
Correlations for Δx with CR-CO differences and Δz with CR-CO differences.

CR-CO Difference	Correlations (n=68) Δx r	Δz r
PCB:RH	0.34**	0.018
SNGoME	0.72*	0.018
ANB	0.63*	0.36**
SNB	0.69*	0.49*
ArGoMe	0.06	0.23
SArGo	0.06	0.23
NSAr	0.56*	0.29***
FT	0.72*	0.18
FA	0.63*	0.54*
LFH	0.69*	0.12
IA	0.26***	0.026
YA	0.13	0.05
FHGoMe	0.27***	0.003
AB	0.11	0.12
AC	0.14	0.19
FAngle	0.18	0.17
PogNB	0.67*	0.15
L1NB	0.67*	0.15
OJ	0.73*	0.25***
L1APog	0.79*	0.26***
PogNV	0.59*	0.35**
LAFH	0.10	0.16
U1APog	0.09	0.06

* r ≥ 0.390 at 0.001 level
** r ≥ 0.310 at 0.01 level
*** r ≥0.239 at 0.05 level

Table VI
Standard error of differences for 10 double measures.

	Measure	Standard Error
Ratio	PCB:RH	3.75
Angles	SNGoMe	1.24
	ANB	0.66
	SNB	0.86
	ArGoMe	1.42
	SArGo	2.48
	NSAr	1.87
	FT	1.17
	FA	0.89
	LFH	0.79
	IA	1.76
	YA	0.60
	FHGoMe	1.26
	AB	0.66
	AC	0.57
	FAngle	2.94
Linear	PogNB	0.44
	L1NB	0.53
	OB	0.61
	OJ	0.64
	L1APog	0.31
	PogNV	1.78
	LAFH	1.40
	U1APog	0.58

ing significance. In the study of the full sample the p values are highly significant for PCB:RH and FA and definitely not significant for SArGo.

Discussion

For the sample of 68 cases, centric relation (CR) was significantly different from centric occlusion (CO) for 21 out of 24 measures of mandibular position. In all cases the mandible was positioned more posteriorly in CR. Thus the centric relation tracings had a greater angle of convexity (NAPog), an increase in ANB and a decrease in facial angle (FHNaPog), and were all significant thus confirming the findings of Wood[3] for those same angles.

Williamson et al.,[4] using Wood's "centric-ceph" technique, compared cephalometric measures between CO and CR for 18 Angle Class I cases and 28 Angle Class II cases. Their results for the Class I cases showed statistically significant differences for 2 out of 7 measures (angle of convexity and lower face height). The present study found significant differences for 20 out of 24 measures between CO and CR for the Class I cases. The Class II group in the Williamson et al. study exhibited significant differences between CO and CR for 4 out of 7 measures (convexity, L1APog in mm and degrees, and lower facial height) whereas in the present study 19 out of 24 measures reached significance. The differences observed upon comparing other studies with the present one may be due to their smaller sample sizes, but are most likely due to methodology. The use of MPI readings obtained from mounted diagnostic casts gives the present study a measure of accuracy not found in the studies reported by Wood[3] and Williamson et al.[4] A precise centric relation tracing can then be formulated for each patient using the exact magnitude of condylar discrepancy.

In the present study, the large sample size (n=68) was sufficient to achieve statistical significance for the differences between CR and CO for all cephalometric measures evaluated except articular angle, overbite and lower anterior facial height. One would not expect a change in overbite due to the CR-CO conversion method which uses the initial CO overbite. This explains why LAFH is not modified either, since the distance from ANS and menton remains stable. Furthermore, when the mandible is repositioned from CO to CR, the position of point S does not change, and points Ar and Go making up the articular angle move together toward S.

With the significant differences in the cephalometric measures from CO to CR, the following effects may be observed:

1. In cases with a large discrepancy, an increase in ANB can signify that what appeared to be a Class I skeletal pattern in CO will be a Class II when observed in CR.
2. Other values such as a reduced SNB, reduced facial taper, and reduced facial angle indicate a more retruded mandible, thereby worsening a Class II situation.
3. An increase in mandibular plane angle, an increase in y axis, and a decrease in facial axis all portray a vertical growth direction, which is generally thought to be more difficult to treat than horizontal growth.
4. Finally, an increase in the value of pogonion to nasion perpendicular and increased overjet may indicate a need for orthognathic surgery rather than orthodontic treatment alone. One would prefer to diagnose this type of problem before treatment commences and avoid unmasking a more severe malocclusion later on. The conversion of the traditional centric occlusion cephalogram to centric relation will accomplish that.

Williamson et al.[4] reported that the discrepancies between CO and CR were greater in Angle Class II cases than in Angle Class I cases. In the present study, the skeletal Class I and Class II subjects had, on average, fairly similar differences between CO and CR. The differences may be explained by the criteria established for the Class I and Class II selection and the method for determining condylar discrepancy.

In analyzing the nature of the condylar movement from CR to CO, all of the patients in the sample had a vertical (Δz) distraction of the condyle that ranged from 1.0 mm to 4.5 mm. For 63 of the 68 patients the range of horizontal (Δx) distraction of the condyle was from 0 mm to 3.0 mm distally, but for 5 patients the condyle moved forward. For those five patients there was a vertical distraction as well. In centric relation the condyle is seated in its most superior anterior position against the disc. When a patient exhibits a molar fulcrum as described by Roth[14] from centric relation position into maximum intercuspation (CO) the condyle has to move down vertically and most often there is a distal component as well. Analysis of the condylar movements recorded in this study (see Figure 1) shows exactly what Roth[14] described. By definition, the condyle cannot move forward without an inferior vertical component if it has been seated superiorly and anteriorly against the disc initially.

Further examination of the condylar movements revealed that 65 out of 68 patients (96%) had a vertical component greater than the horizontal one. As expected, every patient exhibited a vertical condylar discrepancy and there was no horizontal component without a vertical one. In fact, seven patients (10%) had only a vertical component. The size of the horizontal component of condylar distraction to CR-CO difference correlated for 50% of the cephalometric measures, which lends support to the initial hypothesis. However, there was really no relationship found between the size of the vertical component of condylar distraction to CR-CO difference for the sample studied.

In the present study Δx and/or Δz were found to be greater than 2 mm in 50% of an orthodontic population (68 out of 131 patients). Twenty-five percent of the 131 cases had a condylar distraction ≥3 mm. It is not possible to determine chairside which patients will have a large discrepancy. The significant difference in cephalometric measures of the mandible positioned in CR and in CO reinforces the need to mount every case and diagnose the malocclusion from centric relation. The other added benefit of mounted diagnostic casts is a documentation of condylar position at the start of orthodontic treatment.

One goal in orthodontic treatment is to protect the temporomandibular joint. Therefore a treatment goal approaching centric relation in every patient would be desirable. In a society where the incidence of litigation has increased, orthodontists interested in functional occlusion may have the ability to defend themselves with records of condylar position before and after orthodontic treatment.[15]

Aubrey[5] reinforces the need to finish cases in centric relation occlusion and to remove functional interferences. He also views the importance of CR as a stable, reproducible, and comfortable position for the temporomandibular joint. The presence of occlusal interferences creates problems such as subluxation of the joint and eventual occlusal wear, especially when there is a lack of anterior guidance.

There is a need to study in more depth the CR-CO discrepancy as it relates to cephalometrics. This would demand a longitudinal CR-CO discrepancy study (MPI readings) with pretreatment, posttreatment, and postretention values for the same sample. The data have shown that centric relation should be considered as the starting point for proper diagnosis and treatment planning.

Conclusions

1. Measures of mandibular position were significantly different between a centric occlusion tracing and the same tracing converted to centric relation.

2. The differences appeared to apply equally between the skeletal Class I and Class II groups, or between males and females.

3. The condyle was always vertically distracted and most often positioned distally when the teeth were in centric occlusion.

4. The vertical component (Δz) was almost always greater than the horizontal (Δx) component.

5. To avoid errors in diagnosis, treatment plans should be formulated from lateral cephalograms that have been converted to centric relation.

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