The use of a deprogramming appliance to obtain centric relation records

Paul J. Karl, DDS, MClD; Timothy F. Foley, DDS, MClD

Abstract: The purpose of this study was to investigate the effect of an anterior flat plane deprogramming appliance (Jig) in 40 subjects for whom centric relation (CR) records were obtained before and after the use of the appliance. Incisal overbite and overjet dimensions and three-dimensional instrument condylar representation using the Panadent condylar path indicator (CPI) were recorded from maximum intercuspation and centric relation. Subjects were assessed subjectively to determine the degree of difficulty manipulating the mandible to obtain the centric relation record. The mean overbite difference from maximum intercuspation (MI) to centric relation without (CR) and with (CRJ) the appliance were statistically significant and decreased 1.58 mm and 2.23 mm, respectively. The mean overjet values from MI to CR and CRJ were statistically significant and increased .44 mm and .57 mm, respectively. Significant differences were determined on the Panadent articulator for the absolute vertical (Z) and absolute horizontal (X) values for centric relation with and without the appliance. The number of subjects who exceeded the threshold values of 2 mm for CPI recordings in either the horizontal or vertical direction was 7 (18%) from MI to CR and 16 (40%) from MI to CRJ. The Lucia-type jig deprogramming appliance provides a centric relation record with greater displacement from MI than a centric relation record alone. This appliance may be a useful adjunct in a patient where mandibular manipulation in taking a centric relation bite registration is deemed not easy.

Key Words: Anterior deprogramming appliance, Articulator, Bite registration, Centric relation, Condylar displacement

Gnathologists and restorative dentists have suggested using centric relation to provide a stable and reproducible position to reconstruct the dentition.[1-4] The importance of occlusion in orthodontic treatment varies among clinicians.[5] Mounting dental casts in centric relation on a semiadjustable articulator aids in the diagnosis of the malocclusion[6-8] and may reveal a malocclusion that is more severe than that seen with teeth in maximum intercuspation.[6,8-10]

Centric relation (CR)[3,6,11,12] is defined as the relationship of the mandible to the maxilla with properly aligned condyles and discs in the most superior position against the eminentia. Centric occlusion (CO)[12] is defined as the occlusion of opposing teeth when the mandible is in centric relation, which may or may not coincide with the maximum intercuspation (MI) position. Maximum intercuspation is defined as the complete intercuspation of opposing teeth independent of condylar position.[13] Okeson[14] said of centric relation that the "most orthopedically stable joint position is when the condyles are in their most superior anterior position in the articular fossa, resting against the posterior slopes of the articular eminences, with the articular discs properly interposed."

A variety of clinical techniques can be used to register the mandible in centric relation.[3,6,16,17] The Lucia jig[15] and leaf gauge[16] are examples of techniques that use anterior stops to aid in capturing centric relation position. Because the lower anterior teeth occlude on an incline, care must be used to avoid driving the condyles distally. The use of an anterior stop separates the posterior teeth, eliminating tooth interferences that could guide the mandible into maximum intercuspation.

Lundeen[17] found that heavy contraction of the masticatory muscles with the use of an anterior stop seated the condyles in the most superior position. Teo and Wise[18] used an anterior jig with an interocclusal record lined with temporary cement and reported that biting with a clenching force on an anterior jig with chinpoint guidance seated the condyles in the most superior position. Wood et al.[19] compared condylar seating between three bite force levels and observed the maximum superior and anterior seating of the condyles when maximum bite force

Author Address
Dr. Tim Foley
The University of Western Ontario
Faculty of Dentistry
Division of Graduate Orthodontics
London, Ontario, Canada N6A 5C1
E-mail: tfoley@julian.uwo.ca

Submitted: May 1997, **Revised and accepted:** December 1997
Angle Orthod 1999;69(2):117-125 Commentary by Richard P. McLaughlin, DDS

was used. Wood and Elliott[20] found that the Roth power centric relation registration technique was highly reproducible.

Muscles may change the position of the jaw in the presence of occlusal interferences in an attempt to protect the interfering teeth from potentially absorbing the entire force of the closing musculature.[3,14,21,22] The constant repetition of the proprioceptive trigger receptors to the muscles cause them to become patterned to the deviated closure, and these memorized patterns of muscle activity are called muscle splinting or "engrams."[3,14] This muscle activity may prevent the condyles from seating appropriately when taking a centric relation wax registration.[6,23,24] Dawson[3,23] and Slavicek[24] instruct the patient to relax with cotton rolls between their teeth in an attempt to deprogram the masticatory muscle engrams. Boucher and Jacoby[25] suggest that muscle splinting (engrams) may prevent full condylar seating. Williamson et al.[26] studied the effect of full coverage splint wear on the location of the mandibular hinge and found that the axis moves anterosuperiorly 1 mm with splint wear. Since the condyles are loaded during function,[27] taking a centric relation bite registration[4] with the patient seating the condyles using bite force seems appropriate.

Use of an anterior deprogramming appliance[3] may be suggested when mandibular manipulation to obtain a centric relation record is difficult due to interference from muscle splinting (engrams).[3,28] By increasing the vertical dimension and separating the posterior teeth, the occlusal interferences to centric occlusion are removed. In the presence of signs and symptoms of temporomandibular dysfunction, a full arch appliance is indicated to limit loading on the joint.[28-30] These approaches attempt to allow the muscles to relax and allow the condyles to seat more superiorly and anteriorly to reveal the true discrepancy between the mandibular position in centric occlusion and maximum intercuspation.

It was hypothesized that the use of an anterior Lucia-type jig deprogramming appliance for approximately 6 hours could help identify a greater amount of mandibular distraction when obtaining a centric relation record. The purpose of this study was to investigate the difference between centric relation bite registrations taken before and after use of an anterior deprogramming appliance. Condylar positions in the horizontal, vertical, and transverse dimensions were compared, as well as incisal overbite and overjet values.

Materials and methods

The sample consisted of 40 undergraduate dental students (29 males, 11 females) without any temporomandibular dysfunction symptoms or functional deviations as identified by the Helkimo scale.[31] Informed consent was obtained from each subject and ethics approval was granted. The sample, based on Angle's molar classification, consisted of 28 Class I subjects, 11 Class II subjects, and 1 Class III subject.

Impressions of the maxillary and mandibular dentitions were taken using an irreversible hydrocolloid material (Jeltrate Plus, Dentsply International, Inc, Milford, Del) in nonperforated rimlock trays. Casts were made using hard die stone (Vel-Mix, Kerr Manufacturing Co, Romulus, Mich). An estimated hinge axis facebow (Panadent Corp, Grand Terrace, Calif) measurement was taken for mounting on the Panadent (Panadent Corp, Grand Terrace, Calif) articulator. A centric relation bite wax (Bite Registration Wax, Delar Corp, Lake Oswego, Ore) registration was obtained using the Roth power centric relation registration technique.[20] A maximum intercuspation (MI) wax record was taken using pink baseplate wax (10X Wax, Moyco Industries Inc, Philadelphia, Pa).

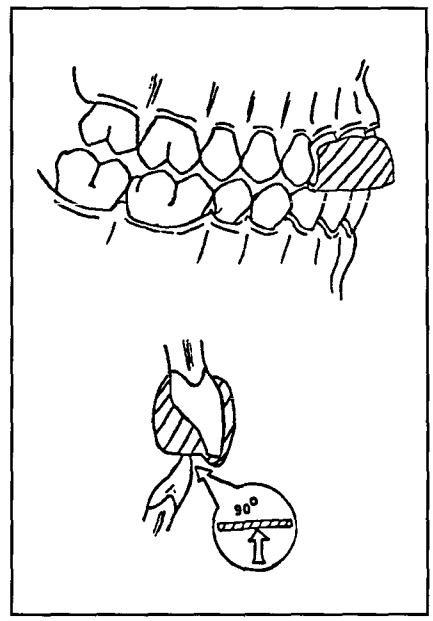

Figure 1
Anterior deprogramming appliance

A custom anterior deprogramming appliance was fabricated at chairside. It consisted of an acrylic, preformed, blank Lucia-type jig (LD Pankey Institute for Advanced Dental Education, Key Biscayne, Fla) relined with orthodontic acrylic (Orthodontic Resin, Caulk Dentsply, Milford, Del) to cover the two maxillary central incisors (Figure 1). The occluding surface was adjusted to contact the lower incisors at a 90 degree angle, permitting the remaining teeth to disclude upon closure. Dental floss was attached through a hole in the body of the appliance. The patient was instructed to tie the free end of the floss to his or her sleepwear to prevent accidental aspiration and to leave the anterior deprogramming appliance in place until the next morning, when a second Roth power centric relation registration bite was taken.

The ease of mandibular manipulation was recorded for each subject upon taking the first wax bite registration. The subjective notation of 1, 2, or 3 was used, with 1 being the easiest to manipulate, 2 being not easy, and 3 the most difficult.

The casts were mounted on a

Panadent articulator using quick set mounting stone (Snow White Plaster #2, Kerr Mfg Co, Romulus, Mich) using a split cast mounting procedure[32] for the maxillary cast. Any failure to hold the shim stock (Shimstock, Hanel Corp, Nuirtigen, Germany) between the mounting plaster and the maxillary cast base was counted as an inaccurate mounting that required immediate remounting. To improve accuracy and consistency, the following protocol was followed.

1. The casts were groomed under 3x magnification to remove any unwanted artifacts.
2. A piece of .0005 inch shim stock was interposed in the split cast mounting to check the accuracy of the laboratory mounting procedure.
3. All condylar path indicator measurements were performed under 10x magnification.
4. The wax bite was trimmed with a scalpel to index only the cusp tips.

In order to maintain consistency of the method, one experienced operator managed all the technical steps. Each subject's casts were mounted and measured using the first centric relation bite registration and immediately remounted and measured using the second centric relation bite registration. This procedure allowed the paper flags of the condylar path indicator to be left on the instrument until both centric relation registration positions were marked, thus eliminating recording error. The condylar path indicator instrument and the Panadent articulator were rechecked after every fifth patient to ensure consistent measurement on the paper flags.

Overbite and overjet values were measured with the teeth in maximum intercuspation and centric relation with and without the use of the deprogramming appliance. These measurements were recorded to the nearest .01 millimeter using a machinist's dial caliper. The linear distance of the articulator condyle position differences between the two centric relation bite registrations was measured in millimeters in the horizontal, vertical, and transverse planes. For each of the subject's mountings, centric slides were assessed in the sagittal and transverse planes at the articulator condyles using a condylar position indicator (CPI). Horizontal, vertical, and transverse changes were measured on the Panadent CPI in the respective x-, z- and y-axes. These measurements were recorded to the nearest .10 millimeter using a 10x lens fitted with a magnified grid calibrated to tenths of a millimeter.

An original method was devised to more accurately measure the average CPI instrument condylar distraction from centric relation. The values for distraction on the CPI instrument were recorded using the following sign convention:

1. Horizontal (x) direction given a positive (+) sign for the mesial direction or a negative (-) sign for the distal direction
2. Vertical (z) direction given a positive (+) sign for the inferior direction or a negative (-) sign for the superior direction
3. Transverse direction given a positive (+) sign for the right side or a negative (-) sign for the left side.

Average negative and positive values would cancel each other out and not be meaningful in assessing the average magnitude of the CPI instrument condylar distractions. Therefore, absolute values were compared. For example, in calculating the average distraction for two subjects, one subject's measurements might reveal a mesial (+) 1.0 mm distraction, while the other subject's measurements might reveal a distal (-) 1.0 mm distraction. The actual average distraction would be (-1.0+1.0)/2=0 mm, which could be considered an incorrect conclusion since both subjects measured a 1.0 millimeter distraction.

The overbite and overjet measurement differences obtained for each subject and CPI measurements were analyzed using paired *t*-tests. The *p*-value was set at .05 for statistical significance. Since multiple *t*-tests were used, the Bonferroni[33] adjustment for the *p*-value was used. The *p*-value was lowered because there was a greater chance for Type I error with multiple *t*-tests. The formula used was p=alpha/k, where k=7 is the number of *t*-tests performed. Therefore, the critical *p*-value for statistical significance in this study was set at .007.

Error study 1

Paired *t*-tests were used to compare the reproducibility of the centric relation wax bite registration for 14 randomly chosen subjects. A second centric relation registration was taken immediately after the first, and both were mounted on the Panadent articulator and CPI; overbite and overjet measurements were compared.

Error study 2

Paired *t*-tests were used to compare the reliability of the laboratory technique using 10 randomly chosen subjects. The centric relation registration was mounted twice on the Panadent articulator and CPI; overbite and overjet measurements were compared. The CPI measurements for the two mountings were compared by standard errors of double measurements. The standard error of double measurement was calculated using the Dalberg equation:

$$SE = \sqrt{Sd^2/2n}$$

where d^2 is the sum of the squared differences between the two mountings and n is the number of subjects.

Results

The mean and standard deviation values for overbite and overjet measurements taken in maximum intercuspation (MI), centric relation without jig (CR), and centric relation with jig (CRJ) are listed in Table 1

and displayed in Figure 2. The mean MI values for overbite and overjet were 4.14 mm and 3.33 mm, respectively, compared with the mean CR values of 2.56 mm and 3.77 mm. The mean CRJ values were 1.91 mm and 3.90 mm.

The mean changes for the overbite and overjet measurements calculated between MI, CR, and CRJ are shown in Table 2. The mean decrease in overbite was 1.58 mm from MI to CR, 2.23 mm from MI to CRJ, and .65 mm from CR to CRJ. The mean increase in overjet was .44 mm from MI to CR, .57 mm from MI to CRJ, and .13 mm from CR to CRJ. All the overbite differences were statistically significant. The overjet differences were statistically significant from MI to CR and from MI to CRJ, but not from CR to CRJ.

The articulator condylar distractions were measured using the condylar position indicator (CPI); mean values and standard deviations are shown in Table 3 and displayed in Figure 3. The average horizontal (x) displacement absolute value was 1.17 mm from MI to CR, and 1.54 mm from MI to CRJ. The average vertical (z) displacement absolute value was 1.19 mm from MI to CR and 1.76 mm from MI to CRJ. The transverse (y) displacement absolute values were .45 mm MI to CR and .51 mm from MI to CRJ.

The mean changes for CPI measurements taken in CR and CRJ are shown in Table 4. The average absolute horizontal and absolute vertical mean displacement from CR to CRJ was .37 mm and .58 mm, respectively, and the transverse was .06 mm. The horizontal (x) and vertical (z) condylar absolute value measurements were statistically significant from CR to CRJ. The transverse differences, however, were not significantly different.

The articulator condyle horizontal (x) displacement for averaged over 2 mm 6 subjects (15%) from MI to CR, and over 2 mm for 12 subjects (30%) from MI to CRJ. The articulator condylar vertical (z) displacement averaged over 2 mm for 5 subjects (13%) from MI to CR, and over 2 mm for 14 subjects (35%) from MI to CRJ. The articulator transverse (y) displacement averaged over .5 mm for 12 subjects (30%) from MI to CR, and over .5 mm for 18 (45%) subjects from MI to CRJ.

The subjective notation for mandibular manipulation for this sample revealed 15 subjects as difficult, 14 as medium, and 11 as easy. The number of subjects who went over the threshold of 2 mm in either the horizontal (5/7) or vertical (6/7) direction on the CPI instrument was 7 (18%) for MI to CR. Of these 7 subjects, 2 were categorized as hard to manipulate when taking the wax bite registration and 5 were categorized as not easy to manipulate. Sixteen (40%) subjects recorded above the threshold value of 2 mm in either or both the horizontal (12/16) or vertical (14/16) direction from MI to CRJ. Nine of these subjects would not have been identified without jig wear and subsequent wax bite registration. Of these 16 subjects, 7 were categorized as hard to manipulate when taking the wax bite registration, 7 as not easy, and 2 as easy to manipulate.

Error study 1 showed that there was no statistical difference between the two consecutive centric relation registrations mounted with the same stone casts (Table 5). Error study 2 also showed there was no statistical difference between the cast mountings using the same centric re-

Table 1
Means and standard deviations (mm). Overbite and overjet for maximum intercuspation, centric relation without jig, and centric relation with jig

	Maximum intercuspation		Centric relation without jig		Centric relation with jig	
	Mean	SD	Mean	SD	Mean	SD
Overbite	4.14	1.74	2.56	1.89	1.91	1.97
Overjet	3.33	1.78	3.77	1.82	3.90	1.96

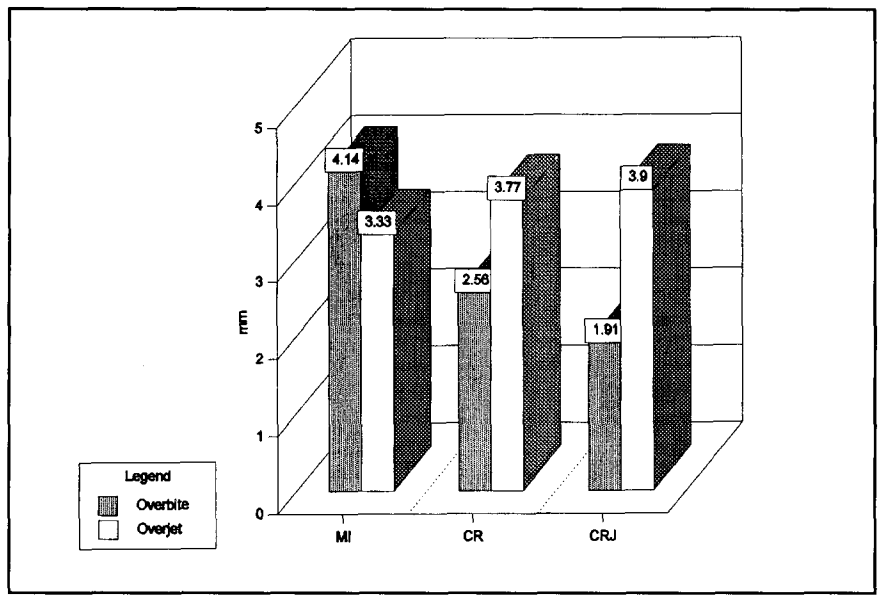

Figure 2
Overbite and overjet values for maximum intercuspation, centric relation (CR), and centric relation with jig (CRJ)

lation registration (Table 6). The standard error of double measurement was also calculated for all three components of the CPI. Table 7 lists the standard errors, all of which were .19 mm or less for each x, y, and z component direction, and all of which fell short of statistical significance. (Table 7) The error studies confirmed the repeatability of the centric relation records.

Table 2
Mean changes (mm) and *t*-tests for paired sample of overbite (OB) difference and overjet (OJ). Difference between maximum intercuspation, centric relation with and without jig

	Maximum intercuspation to centric relation without jig			Maximum intercuspation to centric relation with jig			Centric relation without jig to centric relation with jig		
	Mean	*t*	*p*	Mean	*t*	*p*	Mean	*t*	*p*
OB diff	1.58	8.86	.000	2.23	11.58	.000	.65	4.97	.000
OJ diff	-.44	-3.64	.001	-.57	-3.93	.000	-.13	-1.72	0.94

Discussion

The usefulness of any adjunct treatment appliance is dependant upon the ease of fabrication and the clinician's ability to identify patients who might benefit from the appliance. In this sample, significant differences between CR and CRJ were noted in overbite, absolute value horizontal (x), and absolute value vertical (z) dimensions when using the anterior deprogramming appliance, especially in subjects deemed to be not easy to manipulate. One may suggest that the significant values determined by this study may not be clinically significant, for example the mean overbite difference of .65 mm between CR and CRJ. However, this mean value may not account for the patient whose mandibular manipulation in obtaining a centric relation record was not easy and who presented with clinically significant values. The goal of using the jig was to facilitate the individual determination of clinically significant distraction values that would warrant a CR conversion of the cephalogram to aid in the treatment planning decision.

Overbite differences were significant from MI to CR and from CR to CRJ. This incisal overbite discrepancy is clinically important because it can influence the treatment mechanics selected in orthodontic therapy. With less incisal overbite, an openbite tendency may be exposed, which is especially important when treating adults. The overjet increase was greater than 2 mm in only 2 subjects with and without use of the jig.

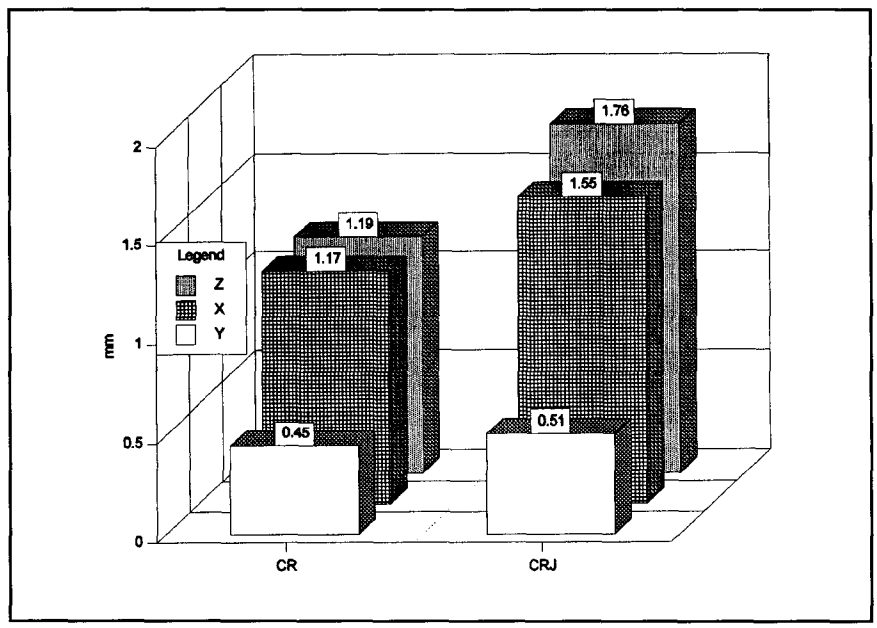

Figure 3
Mean CPI absolute measurements from maximum intercuspation to centric relation with and without jig

In the current study, it did not appear that jig wear affected the overjet measurement. Pullinger and Seligman[34] studied overbite and overjet norms in both control and TMD-affected individuals. In the control group, mean overbite values were 2.89 mm for females and 2.17 mm for males, and mean overjet values were 2.43 mm for females and 1.59 for males. The control sample consisted of 21% Class II, compared with 28% in the current study. In the present study, the subjects had a mean overbite of 4.14 mm in MI and a mean overjet of 3.33 mm.

Wood and Elliott[21] found 6 subjects who had initial MI overjet greater than or equal to 5 mm, suggesting that most of their sample was Class I. Williamson et al.[35] observed that the discrepancy between MI and CR was greater in Class II patients than in Class I cases. They found that 5 of 28 (18%) Class II subjects had an anterior slide of 2.5 mm or greater, compared with 2 (11%) of the Class I subjects, who showed an anterior slide of 1.5 mm or more. The present study does not support this observation, since there were no Class II subjects with an anterior slide of over 2.5 mm. It may not be possible to identify patients with large slides based on Angle classification. Wood and Elliott[21] did not stabilize their sub-

jects on a muscle relaxation splint and suggested a larger discrepancy might have been found with splint use. In this study, overjet increased from MI to either CR bite registrations for most subjects, which is in agreement with the findings of Wood and Elliott[21] and Shildkraut, Wood and Hunter.[36] The overjet increase of over 2 mm from MI to CR found in 2 subjects in this study was similar to that of Wood and Elliott,[21] who observed similar changes in 3 of 39 subjects.

If the mandible is not easy to manipulate, then the use of an anterior deprogramming appliance may be suggested as an alternative method to obtain a centric relation record. Of the 29 subjects categorized either as not easy or hard to manipulate, 14 (48%) went over the 2 mm threshold in the x (horizontal) or z (vertical) direction, doubling the number of subjects identified with appliance wear. In this sample, it was not possible to predict which subjects were not easy or hard to manipulate based on their Angle classification.

The low error found in both error studies (high *p*-values) showed that obtaining a centric relation wax bite registration and transferring the relationship to the articulator can be accomplished very accurately. When casts are mounted inaccurately, the usefulness of any articulator diminishes.[14] The standard error of double measurement was calculated for this sample and was found to be less than .2 mm in any direction. Wood and Elliott[21] performed the same error study and found the standard error of double measurement to be .3 mm or less in any direction. Likewise, Wood and Korne[37] found similar errors of .25 mm or less in all three directions using slightly different instrumentation.

If significant condylar distraction is observed with the centric relation bite registration, then cephalometric measurements on a CO cephalogram will be impacted.[6,7,35,36] Shildkraut et al.[36] studied the CR to CO discrepancy and its effect on cephalometric radiograph measurements and reported statistically significant differences in 21 of 24 measurements. If there was an average of 2 mm or greater distraction in the horizontal (x) or vertical (z) direction, it was suggested that the lateral cephalometric radiograph be converted to reflect centric relation.[36] In this study, 16 (40%) subjects went over the threshold of 2 mm with appliance use, indicating its usefulness in diagnosis.

In this study, the first CR bite registration without jig use identified 7 (17.5%) subjects who would have had

Table 3
Means and standard deviations (mm) of CPI absolute value measurements from maximum intercuspation to centric relation without jig and centric relation with jig

	Centric relation without jig		Centric relation with jig	
	Mean	SD	Mean	SD
Horiz. rt. abs.	.99	.76	1.30	.86
Horiz. lt. abs.	1.34	.64	1.77	.99
Horiz. average	1.17		1.54	
Vert. rt. abs.	.91	.89	1.46	1.15
Vert. lt. abs.	1.46	1.26	2.06	1.50
Vert. average	1.19		1.76	
Trans. abs.	.45	.41	.51	.40

Table 4
Mean changes (mm) and *t*-tests for paired samples of CPI absolute value measurements between centric relation with and without jig

	Centric rel. without jig to centric rel. with jig		
	Mean	*t*	*p*
Horiz. rt. abs.	-.31	-3.48	.001
Horiz. lt. abs.	-.43	-3.19	.003
Horiz. average	.37		
Vert. rt. abs.	-.55	-4.73	.000
Vert. lt. abs.	-.60	-5.05	.000
Vert. average	-.58		
Trans. abs.	-.06	-.92	.36

Table 5
Error study 1. Mean changes (mm) and *t*-tests for paired samples of absolute value measurements between two consecutive centric relation registrations

	Mean	*t*	*p*
Overbite	-.06	-.93	.37
Overjet	-.07	-.72	.49
Horiz. rt. abs	-.08	-.97	.35
Horiz. lt. abs	-.12	-1.16	.27
Vert. rt. abs.	-.12	-1.72	.11
Vert. lt. abs.	-.01	-.15	.89
Trans. abs.	-.09	-1.22	.24

Table 6
Error study 2
Mean changes (mm) and *t*-tests for paired samples of absolute value measurements between two consecutive mountings of the same centric relation registration

	Mean	*t*	*p*
Horiz. rt. abs.	-.04	-.05	.63
Horiz. lt. abs.	-.02	-.31	.76
Vert. rt. abs.	-.13	-1.34	.22
Vert. lt. abs.	-.28	-1.84	.10
Trans. abs.	-.13	-1.62	.14

Table 7
Reliability of laboratory technique. Standard errors of double measurement* of two separate CPI readings from the same centric relation bite registration mounted twice (n=10)

Component	Error (mm)
X	.17
Z	.19
Y	.19

their lateral cephalometric radiographs converted. Utt,[38] using centric relation for all his subjects, found that 18.7% were over the threshold of 2 mm in the horizontal or vertical direction. He did not mention if he used absolute values in calculating mean horizontal or vertical distractions, which might have resulted in reporting smaller mean average distraction values. He found that these patients could not be identified by the Angle molar classification, ANB angle, sex, or age. Kinderknect et al.[39] studied the effect of an anterior deprogramming on 20 subjects for the terminal transverse horizontal axis (horizontal distraction). They found after 12 hours of deprogramming appliance wear that the amount of position change of the terminal transverse horizontal axis was less than .5 mm, as compared with 1.54 mm in the present study. Since differences were small, they did not attempt to identify the patients who could benefit from appliance usage, nor did they study the vertical nature of the condylar distraction. In the present study, it was found that the articulator condyles moved superiorly and mesially from MI to either CR bite registration position in the majority of the subjects, which is in agreement with previous studies.[21,36,40]

It has been suggested that an accurate centric relation record can be achieved after using a muscle relaxing repositioning splint in a patient without TMD symptoms.[6] If the mandible is not easy to manipulate, splint wear may be helpful[29] in allowing the mandible to seat into a more stable centric relation position.[6] The easiest, least time-consuming, and least expensive method to help minimize muscle splinting (engrams) appears to be the use of cotton rolls between the teeth, as advocated by Dawson[3,23] and Slavicek.[24] However, if the centric relation record is in question, the use of an anterior deprogramming appliance will provide a quick, practical approach to improving mandibular manipulation and centric relation registration.

Conclusions

Centric relation bite registrations were compared for 40 subjects before and after use of an anterior flat-plane deprogramming appliance for approximately 6 hours. CPI, overbite, and overjet measurements were compared. The findings were as follows:

1. Overbite differences are statistically significant from MI to CR and from CR to CRJ. The bite opened 1.58 mm from MI to CR and 2.23 mm from MI to CRJ.

2. Overjet differences are statistically significant from MI to CR but not from CR to CRJ. Overjet increased .44 mm from MI to CR and.57 mm from MI to CRJ.

3. Mean absolute value differences are statistically significant for CR to CRJ for the horizontal (x) and vertical (z) directions, but not the transverse (y), using the Panadent CPI instrument.

4. There is an 18% chance for detecting a CPI-articulated condyle measurement of more than 2 mm distraction in either the horizontal or vertical direction with a CR bite registration alone, which more than doubles to 40% with use of an anterior deprogramming appliance

5. The most prevalent type of centric slide results in a posterior and inferior distraction of the articulator condyles from CR to MI.

6. The use of an anterior deprogramming appliance is suggested prior to taking a centric relation registration for a patient whose mandible is deemed not easy to manipulate.

References

1. McCollum BB. Fundamentals involved in prescribing restorative dental remedies. Dental Items of Interest 1939;61:522-539.
2. Stuart CE. Articulations of human teeth. Dental Items of Interest 1939;61:1029.
3. Dawson PE. Evaluation, diagnosis, and treatment of occlusal problems. 2nd ed. St. Louis: Mosby, 1989:28,32,41-45,132.
4. Lucia VO. Modern gnathological concepts—updated. Chicago: Quintessence Publishing, 1983: 146-147.
5. McNamara JA Jr, Seligman DA, Okeson JP. Orthodontic treatment, occlusal factors and temporomandibular disorders. Monograph 16, Craniofacial Growth Series. Ann Arbor: Center for Human Growth and Development, The University of Michigan, 1992; 31:293-302.
6. Roth RH. Functional occlusion for the orthodontist. Part 1. J Clin Orthod 1981;5(1):32-51.
7. Slavicek R. JCO interviews: On clinical and instrumental functional analysis for diagnosis and treatment planning. Part I. J Clin Orthod 1988:22:358-370.
8. Williamson EH. Occlusal concepts in orthodontic diagnosis and treatment. In Johnston LE, ed. New vistas in orthodontics. Philadelphia: Lea and Febiger, 1985:122-147.
9. Wood CR. Centrically related cephalometrics. Am J Orthod 1972;71: 156-172.
10. Parker WS. Centric relation and centric occlusion - an orthodontic responsibility. Am J Orthod 1978;74:481-500.
11. Williamson EH. Occlusion and TMJ dysfunction. J Clin Orthod 1981;15(5):333-410.
12. Glossary of prosthodontic terms. J Prosthet Dent 1987;58:713-62.
13. Van Blarcom CW. Glossary of prosthodontics, 6th ed. J Prosthet Dent 1994; 71:43-104.
14. Okeson JP. Management of temporomandibular disorders and occlusion. 3rd ed. St. Louis: Mosby 1993: 40,112,512,546
15. Lucia VO. A technique for recording centric relation. J Prosthet Dent 1964; 14:492-505.
16. Long JH. Locating centric relation with a leaf gauge. J Prosthet Dent 1973;29:608-610.
17. Lundeen HC. Centric relation records: The effect of muscle action. J Prosthet Dent 1974;31(3):245-251.
18. Teo CS, Wise MD. Comparison of retruded axis articular mountings with and without applied muscular force. J Oral Rehab1981;8:363-376.
19. Wood DP, Floreani KJ, Galil KA, Teteruck WR. The effect of incisal bite force on condylar seating. Angle Orthod 1994;64(1):53-62.
20. Wood DP, Elliott RW. Reproducibility of the centric relation bite registration technique. Angle Orthod 1994;64(3):211-219.
21. Bakke M, Moller E. Occlusion, malocclusion, and craniomandibular function. Current controversies in orthodontics. Quintessence 1991:77-98.