Eur. J. Prosthodont. Rest. Dent., Vol.20, No. 4, pp 151-158
Printed in Great Britain

doi:10.1922/EJPRD_1079Zonnenberg08

Reproducibility of 2 Methods to Locate Centric Relation in Healthy Individuals and TMD Patients

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Abstract - *No conclusive evidence exists for any maxillomandibular relationship as the preferable treatment position. Measurement reliability of 2 different methods to attempt to locate centric relation in control and TMD patients was assessed to determine if both methods lead to the same position. A group of 27 controls and 91 TMD patients were examined using the Research Diagnostic Criteria for TMD (RDC/TMD). Three patient groups were recruited: 27 patients with myofascial pain (MYO), 34 patients with disc displacement without reduction (ID), and 30 patients with osteoarthritis (OA). For each study participant centric relation was located with chinpoint guidance and a technique with a leaf gauge, for the controls once, for all TMD patients before and after stabilization splint treatment. The mixed model procedure revealed no significant differences between the methods, the patient groups and the time interval. However, the patient groups at baseline and conclusion of treatment differed significantly from the controls. The percentage of patients (15.9%) having a coincident split-cast result for both methods was significantly smaller (P<0.001) than the corresponding percentage (85.2%) of controls. After splint treatment, the percentage of coincident split-casts increased from 15.9% to 76.8%. Both methods are reproducible techniques to locate centric relation for control and TMD patients. However, the leaf gauge provides the clinician a different centric relation position in TMD patients than chinpoint guidance does.*

KEY WORDS: Centric relation, TMD, reproducibility, split-cast

INTRODUCTION

Determining the maxillomandibular relationship is a routine procedure in dental practice. Among the decisive factors are first, that the chosen mandibular position must be reproducible, and secondly that this therapeutic position must be physiologically acceptable and comfortable for the patient [1]. The maximal intercuspal position is a stable and clinically readily reproducible treatment position. However, centric relation is universally accepted as the reference position of choice for extensive restorative dentistry [2, 3]. Multiple techniques to determine and transfer centric relation have been studied and proposed, for healthy individuals [4-19], and TMD patients [20-22]. Chinpoint guided computerized axiography [22] shows a high intra-/interrater measurement reliability of the condylar reference position in asymptomatic and symptomatic patients. However, transfer of the maxillomandibular relationship with zinc oxide-eugenol impression paste remains troublesome [22]. Pantography claims to be a diagnostic test for temporomandibular dysfunction rather than a method to locate centric relation [20, 21]. No single approach appears to be superior over another, nor for all clinical circumstances. Among these, bimanual manipulation [8, 10, 12, 18] and chinpoint guidance appear to be often used. Variability of chinpoint guidance has been documented extensively in healthy individuals [23, 24]. Chinpoint guidance allows the operator to determine the most retruded relation of the mandible to the maxilla, when the condyles are in the most posterior, unstrained position in the glenoid fossae from which lateral movements can be made at any given degree of jaw separation [25]. Centric relation has most recently been defined as the maxillomandibular relationship in which the condyles articulate with the thinnest avascular portion of their respective disks with the complex in the anterior-superior position against the shapes of the articular eminencies. This position is independent of tooth contact [25].

Over 5 decades the concept of centric relation has evolved from the most retruded, ligamentous position [5], via the posterior, unstrained position [7] and the uppermost apex of force [8,10] to contemporary thinking, that it is the superior-anterior [3,18] strained position. It is considered impossible to achieve centric relation in TMD patients, since one or more of the criteria of centric relation [10] cannot be fulfilled. However, in many patients an adapted centric posture [10, 18] can be accomplished.

In the presence of musculoskeletal facial pain, the reproducibility of centric relation registrations appears to be questionable [10, 26, 27]. In one study an artificial masticatory muscle disorder was induced by placing 5% hypertonic saline solution into the central portion of the superficial masseter muscle of 5 volunteers. The resulting experimental muscle pain affected the mandibular border movements and the apex of the tracing in both anterior-posterior and transverse directions from 0.0 to 0.6 mm with a mean value of 0.22 mm [27]. All pain-induced effects proved to be reversible.

In the most recent Glossary of Prosthodontic Terms [25], the centric relation position is considered identical to the musculoskeletally stable or stable orthopaedic position

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of the mandible [3]. Clinically this musculoskeletally stable position can be obtained with bimanual manipulation [12, 18], with a jig [18] or, similarly, with a leaf gauge [3, 28-32]. The musculoskeletally stable position with a leaf gauge is located by instructing the patient to "close on the back teeth" and then to protrude the mandible while the incisors maintain contact with the leaf gauge, followed by retruding the mandible, biting on the leaf gauge and relaxing the elevator muscles [29, 32]. Bimanual manipulation in particular is a well-documented and reproducible method [12, 18] to achieve this position. However, the method has been documented for healthy individuals. One of the studies just discussed [12] would suggest that in the presence of pain an accurate location of centric relation may prove difficult.

Any comprehensive treatment of the occlusion, including treatment with a stabilization splint [33], demands a physiologically and functionally acceptable reference position [1-19, 22]. Many clinicians have suggested that treatment goals should include the concept of having the centric relation position of the condyles coincide with the maximal intercuspal position of the teeth [2-18]. Yet, no conclusive evidence exists to either favour or reject any specific centric relation position as the optimally defined treatment position [3]. The purpose of this study was to assess measurement reliability of 2 different methods to locate centric relation, an operator-guided and a muscle-determined technique, to determine if with either method the same centric relation position can be obtained. The null hypothesis was that there would be no differences between the obtained centric relation positions, in healthy individuals and in TMD patients prior to and after stabilization splint treatment.

MATERIAL AND METHODS

In a controlled clinical study measurement reliability was assessed of chinpoint-guided and the musculoskeletally stable centric relation position, in control and in TMD patients. Potential differences between both centric relation positions were tested in the controls and in the TMD patients, at baseline and conclusion of stabilization splint treatment.

The study enrolled a group of healthy individuals and 3 patient groups. One hundred and eighteen individuals participated in this study: 27 control subjects, 8 men and 19 women, recruited at a private dental office, and a group of 91 TMD patients, 16 men and 75 women. The TMD patients presented themselves for treatment at the Clinic of Special Dental Care, Amsterdam, the Netherlands with pain [34]. All subjects were examined with the Research Diagnostic Criteria for TMD (RDC/TMD) [35], Axis I, to diagnose the chief temporomandibular disorder of the patients and to exclude a TMD diagnosis for the control subjects [36]. The data of the RDC/TMD, Axis II of 91 patients were collected as well, however, they will not be discussed within the framework of this manuscript.

TMD patients were allocated to diagnostic subgroups based on one of the following diagnoses from Axis I: 27 patients were diagnosed with a masticatory muscle disorder (n=27), 17 with limited and 10 with unlimited mouth opening, LO and UO respectively; 34 patients were diagnosed with disc displacement without reduction (n=34), 23 of whom had limited opening (L) and 11 without limited mouth opening (O); and 30 patients were diagnosed with osteoarthritis (OA). The study design is presented in Figure 1.

In a power analysis conducted in a previous study [28], the minimally required number of participants was calculated to be 26 subjects per group. From this pilot study the biggest difference [28] was found in variable XL = 0.146 with the corresponding standard deviation SD = 0.153. Variable XL represents one of the 6 variables that determine the condylar axis. Consequently, the power analysis [28] will be represented by $N = 2\ (z_\alpha + z_{2\beta})^2 \times (0.153)^2 / (0.146)^2$ in which z_α is 1.96 at $\alpha = 0.05$ and $z_{2\beta} = 1.65$ at $\beta = 0.95$. All subjects were informed about the nature and objective of a quick-mount procedure and the purpose of this study to compare 2 different methods to record their maxillomandibular relationship. Written informed consent was obtained from all participants in this study. For the comparison of both methods to locate centric relation an IRB approval was obtained from the Medical Ethical Committee of the University of Utrecht, Netherlands.

The study design was double-blinded and controlled using a principal investigator and 2 examiners. The investigator was blinded for the order and method to take consecutive wax records and the examiners for the patient's diagnosis. The principal investigator examined all patients and control subjects and allocated them to the appropriate diagnostic group. At the same appointment 3 impressions were made with irreversible hydrocolloid (CA 37, Cavex), 1 maxillary and 2 mandibular to conduct a quick-mount procedure. These were poured in type IV stone (Fuji Rock; GC). An arbitrary face-bow (Axioquick; SAM-Co) transfer was used to orient the maxillary cast to an articulator (SAM 2P, SAM-Co). Magnetic split-cast mounting plates (Axiosplit, SAM-Co) were used to facilitate the exchange of individual casts from the articulator for the split-cast and measuring procedures. Split-cast mounting is a method of mounting casts wherein the dental cast's base is sharply grooved and magnetically keyed to the mounting ring's base. The procedure allows verifying the accuracy of the mounting by coincidence of the dental cast's base and the mounting ring's base.

At a second visit, 1 out of 2 calibrated examiners, X or Y, prepared 2 identical sets of 3 interocclusal wax records (Fig. 2) that were labelled A and B for blinding purposes (Moyco Wax, Pink X-hard). Next, the available examiner made sequential centric relation records, starting with chinpoint guidance or with the leaf gauge (Huffmann's leaf gauge) technique. A 1-3 and B 1-3 (Fig. 2) wax records were made, representing chinpoint guidance or the technique with the leaf gauge in that particular patient. The sequential wax records were cooled in cold water with ice. The order in which both techniques were recorded, was noted on the patient chart, including the number of leaves used. All wax records consisted of 2 layers of wax, cut to size with scissors.

Wax record sets A and B were returned to the principal investigator for mounting and further instrumental analysis. Wax record A1 and B1 were used to mount a mandibular cast A and B respectively in the articulator. A split-cast procedure was performed to check the accuracy of the 2 mountings. For a correct mounting of the mandibular cast, at least 2 out of 3 wax records A 1-3 and B 1-3 had to show visual coincidence of the dental cast's base and

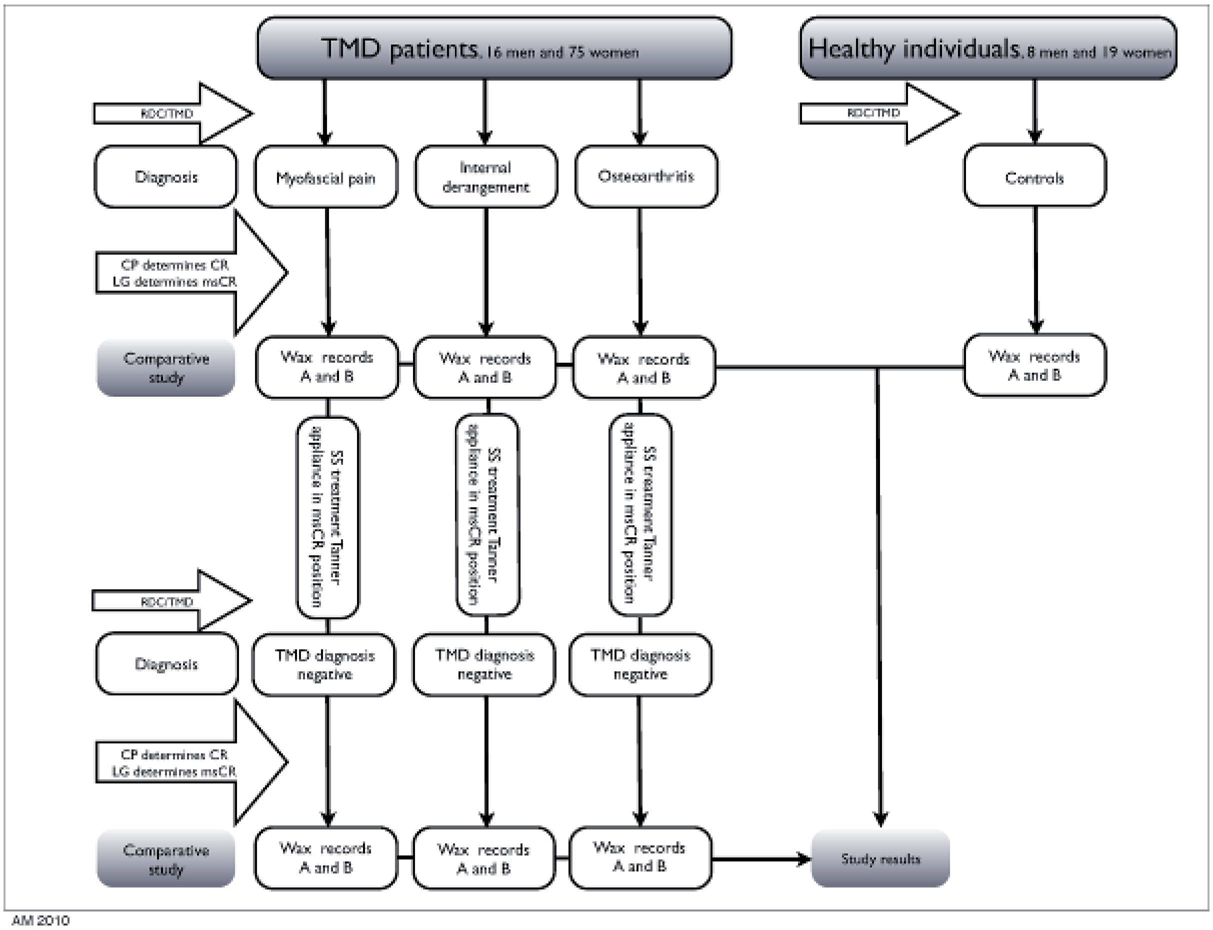

Figure 1. *Flowchart of the study design. CP = chinpoint guidance, CR = centric relation, LG = leaf gauge, msCR = musculoskeletally stable centric relation.*

Figure 2. *Interocclusal wax record series A and B.*

the mounting ring's base. Next wax record B1 was tested on mandibular cast A to determine if the mounting of the mandibular cast A and B were coincident.

The casts were then transferred into the condymeter (Condymeter III; SAM-Co) to quantify the accuracy at the level of the condylar axis. This articulator in lieu of the condylar housing has 2 sets of 3 measuring gauges, each with a measuring range from 0 to 5 mm, subdivided in 0.1 mm increments (Fig. 3 and 4). The instrument has been designed to measure any displacement of the condylar axis along the x, y and z-axes bilaterally. Instrument calibration of the condymeter with a specific calibration tool (Master check P, SAM-Co) was conducted before the assessment of the wax record sets of each individual. This tool sets all gauges at 2.50 mm, being the reference value, when sequential centric relation wax records are assessed (Fig. 4). Of each wax record the instrument provides a dataset of 6 variables: XR, XL, YR, YL, ZR and ZL, representing the displacement at the level of the condylar axis. R refers to the right, L to the left condyle. Only the values of the coincident wax records, A 1-3 and B 1-3, in the split-cast analysis were accepted and recorded. The data of the 6 variables consisted of 2 or 3 values after the split-cast analysis, since at least 2 out of 3 wax records had to be coincident. The mean value of these 2 or 3 values was considered in the statistical analysis.

After instrumental analysis a Tanner type stabilization splint was fabricated on the leaf gauge articulation for each of the

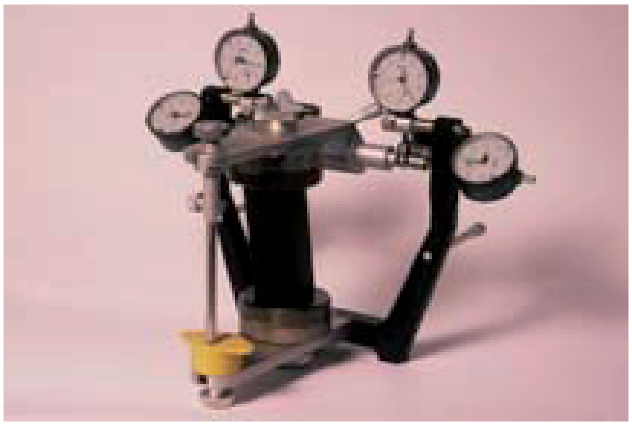

Figure 3. *Condymeter, version III.*

Figure 4. *Detail of Condymeter III.*

Table 1. *Distribution of TMD diagnosis and control subjects. MYO = masticatory muscle disorder, ID = disc displacement without reduction, OA = osteoarthritis*

	Age		*Number*	*Gender*	
Group	*Mean*	*SD*	*N*	*Male*	*Female*
Control	37	14	27	8	19
MYO	32	9	27	7	20
ID	35	15	34	5	29
OA	40	13	30	5	25
All	36	13	118	25	93

Table 2. *Subdivision of participants in study diagnosed with RDC/TMD Axis 1. LO = restricted mouth opening < 40 mm, UO = unrestricted mouth opening, L = without reduction with limited opening < 36 mm, O = without reduction without limited opening*

Diagnosis	*Sub diagnosis*	*n*
Control subjects		27
MYO	LO	16
	UO	10
	Dropout	1
ID	L	21
	O	8
	Dropout	5
OA		28
	Dropout	2

TMD patients [37,38]. A Tanner appliance is a mandibular full-coverage, heat-cured acrylic splint with cuspid-to-cuspid anterior guidance and the lingual, maxillary cusps in contact with the appliance [39]. Splint treatment was continued until resolution of symptoms and the patient reported to be pain-free in a follow-up visit. Next, all patients were re-examined with RDC/TMD, to confirm the absence of the patient's initial TMD diagnosis. The mean time elapsed from the initial TMD diagnosis until the active monitoring of the appliance stopped, was 7.5 months (range 3-12) for the masticatory muscle group, 8.2 months (range 5-12) for the disc displacement without reduction group, and 7.4 months (range 4-12) for the osteoarthritis group respectively. The mean time the splint treatment was monitored, was 5 months (range 2-9) for the masticatory muscle disorder group, 6.8 months (range 3-12) for the disc displacement without reduction group and 5.4 months (range 2-12) for the osteoarthritis group. Next a second quick-mount procedure was initiated. The RDC/TMD, the location of centric relation and the written informed consent of the controls required a single visit.

For the analysis of the variables XL, XR, YL, YR, ZL and ZR a paired *t*-test and a number of mixed models were applied (SAS/STAT, version 9, SAS Institute. Cary NC, USA). The mixed model is a specific ANOVA model with fixed and random factors. The fixed factors methods, diagnostic group and point in time (at baseline and at conclusion of splint treatment) were tested for differences. Subjects were the random factor in each model. The Bonferroni correction was chosen for multiple comparisons of the 3 diagnostic groups. Three extra models were applied to test each of the variables age (continuous), gender (class), and the duration of treatment (continuous) by adding these variables to the first mixed model. To test the duration of treatment between baseline and conclusion of treatment one-way ANOVA was performed. To assess accuracy of the 2 methods a F-test was performed. Fisher's exact tests were performed to test changes in the number of patients having a coincident split-cast result for both methods (CP=LG). A *P*-value of less than 0.05 was considered significant.

RESULTS

Age and gender distribution of the control and the 3 patient groups is listed in Table I. The subdivision of the TMD diagnoses is listed in Table II. Over the duration of the study, attrition was as follows: Of 91 patients, 1 woman dropped out of 27 (3.7%) from the masticatory muscle disorder group (MYO), there were 5 dropouts from the disc displacement without reduction group (ID), 1 man and 4 women (14.7%), and 2 women of 30 (6.7%) dropped out from the osteoarthritis (OA) group. Dropouts occurred for various reasons. Three patients relocated, 3 quit treatment without notice. One patient developed another diagnosis during treatment and 1 patient discontinued treatment as a result of her comprehensive Axis II disorder. Consequently, the data of the condymeter (SAM, Co) from 83 successfully treated patients at baseline and at conclusion of treatment were assessed.

Table 3. *Student's paired t-test of the factor method to locate centric relation in the dataset of the control subjects. CP = chinpoint guidance, LG = leaf gauge*

Variable	*Mean difference CP – LG in millimetre*	*Standard Deviation*	*P*
XL	0.006	0.175	0.84
XR	-0.027	0.140	0.32
YL	0.010	0.107	0.62
YR	-0.010	0.107	0.62
ZL	-0.016	0.164	0.60
ZR	0.015	0.136	0.56

Table 4. *Mean values in millimetres in a mixed model of variables XL, XR, YL, YR, ZL and ZR in comparison of various diagnostic groups at baseline of treatment. Superscripted small characters refer to significant differences between variables of diagnostic groups.*

Group		*XL*	*XR*	*YL*	*YR*	*ZL*	*ZR*
a	ID	2.55^{d}	$2.44^{c,d}$	$2.53^{c,d}$	$2.47^{c,d}$	2.52	2.47^{d}
b	MYO	2.54	2.46^{d}	2.54^{d}	2.46^{d}	2.50^{d}	2.47^{d}
c	OA	2.53	$2.48^{a,d}$	$2.56^{a,d}$	$2.44^{a,d}$	2.49^{d}	2.47^{d}
d	Control	2.51^{a}	$2.52^{a,b,c}$	$2.49^{a,b,c}$	$2.51^{a,b,c}$	$2.55^{b,c}$	$2.57^{a,b,c}$

Table 5. *P values in the mixed model for various diagnostic groups at baseline of treatment.*

Group	*XL*	*XR*	*YL*	*YR*	*ZL*	*ZR*
ID - MYO	0.71	0.26	0.39	0.36	0.52	0.99
ID - OA	0.27	0.02	0.01	0.01	0.16	0.80
ID - Control	0.04	<0.001*	<0.001*	<0.001*	0.14	<0.001*
MYO - OA	0.47	0.24	0.14	0.14	0.47	0.81
MYO - Control	0.11	<0.001*	<0.001*	<0.001*	0.04	<0.001*
OA - Control	0.37	0.03	<0.001*	<0.001*	<0.001*	<0.001*

** denotes significant difference after Bonferroni correction*

Table 6. *Mean values in millimetres in a mixed model of variables XL, XR, YL, YR, ZL and ZR in comparison of various diagnostic groups at conclusion of treatment. Superscripted small characters refer to significant differences between variables of diagnostic groups.*

Group		*XL*	*XR*	*YL*	*YR*	*ZL*	*ZR*
a	ID	$2.57^{c,d}$	2.45^{d}	2.53^{d}	2.47^{d}	$2.49^{b,c,d}$	2.52^{d}
b	MYO	2.55^{d}	2.48^{d}	2.54^{d}	2.46^{d}	2.55^{a}	2.51^{d}
c	OA	2.52^{a}	2.45^{d}	2.54^{d}	2.46^{d}	2.54^{a}	2.49^{d}
d	Control	$2.51^{a,b}$	$2.52^{a,b,c}$	$2.49^{a,b,c}$	$2.51^{a,b,c}$	2.55^{a}	$2.57^{a,b,c}$

Table 7. *P values in the mixed model for various diagnostic groups at conclusion of treatment.*

Group	*XL*	*XR*	*YL*	*YR*	*ZL*	*ZR*
ID - MYO	0.19	0.09	0.73	0.68	<0.001*	0.47
ID - OA	0.02	0.98	0.38	0.32	0.03	0.20
ID - Control	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*	<0.001*
MYO - OA	0.22	0.18	0.55	0.52	0.70	0.49
MYO - Control	0.02	0.02	<0.001*	<0.001*	0.90	<0.001*
OA - Control	0.54	<0.001*	<0.001*	<0.001*	0.77	<0.001*

** denotes significant difference after Bonferroni correction*

In a paired *t*-test no significant differences were found in the control group for the 2 methods to locate centric relation (Table III). The variance of either method was tested for differences, however, the performed F-test showed no statistical significance for any of the 6 variables (P>0.2).

A mixed model was applied to test the random factor (patients) with the fixed factors (3 patient groups, method to locate centric relation and point in time before and after splint treatment). The applied model did not show any significant difference for the factor patient group, method and point in time except for variable ZR in point in time (Estimate of ZR = 0.035, St. Error = 0.012, P=0.004). Age, gender and duration of treatment were included in the analysis and did not significantly influence any of the results.

In the next analysis, controls were compared to the patient groups in 2 separate mixed models, at baseline and conclusion of treatment. The variables in half of the comparisons from the patients at baseline (Table IV and V) as well as after treatment (Table VI and VII) significantly differed from those obtained from the control subjects. The differences (in mm) were the largest for variable ZR between the ID and the control group at baseline (Estimate of ZR = -0.101, St. Error = 0.018, P<0.001).

In a frequency procedure the percentage of patients at baseline who had their chinpoint guided mounting coinciding with their leaf gauge mounting (15.9%) in the TMD groups was significantly smaller than the corresponding percentage (85.2%) of the controls (P<0.001; Fisher's Exact Test). At conclusion of treatment the percentage of patients that had their chinpoint guided mounting identical to the leaf gauge mounting had increased from 15.9% to 76.8% and no longer differed from the percentage of the control subjects 85.2% (P =0.42; Fisher's exact test).

DISCUSSION

The 6 variables XL, XR, YL, YR, ZL and ZR reflect the coordinates of the condylar axis, representing the mandibular position in the articulator (SAM 2P; SAM-Co). The *t*-test indicated that no significant differences were found in the control group between the 2 methods to locate centric relation (Table III). The mean measured difference between the 2 condylar axes ranged from 0.006 ± 0.175 mm in variable XL to -0.027 ± 0.140 mm in variable XR. The non-significant *P*-values (Table III) make obvious that both axes practically coincide. The coincidence of both lines confirms the assumption in the literature that various methods to locate centric relation result in the same mandibular position and confirms the null hypothesis, at least in healthy control subjects[3].

Potential error of vertical dimension exists when making sequential wax records. This problem appears more likely with the chinpoint guidance technique in which no vertical stop is used. The variance of chinpoint guidance is larger than the variance of the leaf gauge technique in the three patient groups. although no significant differences were found (P>0.2). To a certain extent, chinpoint guidance will be influenced by the operator and by the thickness of the wax record; however, the leaf gauge technique has a fixed occlusal stop, relies almost completely upon the dominant influence of the lateral pterygoid muscle [27] and the limitation imposed by the temporomandibular ligament [3]. The difference in variance between the two methods may be attributed to the operator's manipulation. However, such was not significantly different, suggesting that an experienced operator may use either technique according to personal preference. This appears to confirm that the operator's role in the reproducibility of centric relation records is negligible [17,22,32].

In the TMD patients no significant differences were found between the 2 methods to locate centric relation, the patient group and the point in time of splint treatment, confirming comparable accuracy of both methods. Age, gender and duration of treatment added to the model did not influence the outcome. However, by adding the control group to the patient groups, the null hypothesis had to be rejected. The 2 methods, at baseline and at conclusion of SS treatment, showed a significant difference in half of the variables (Table IV – VII). The largest difference was found in variable ZR = 0.10 ± 0.01 mm between the ID and control group at the baseline of SS treatment. In general, the estimates for the difference between the ID and the control group were the largest. Nevertheless, all differences are well within the error of measurement that was documented previously, variable XR in MYO: -0.137±0.112 [28]. Though extremely small, the significant differences between controls and TMD patients could indicate a causal relationship of an unknown factor in TMD patients. Splint treatment does not influence the differences. It is unknown if these differences existed before the TMD developed. However, their magnitude appears to be of limited clinical impact.

As TMD patients often complain that their teeth do not fit together properly, the presumption exists that orofacial pain influences the maxillomandibular relationship and the mandibular excursions. Both relationship and range of motion can be observed by recording a gothic arch tracing. Artificially induced musculoskeletally facial pain was caused by infusion of a hypertonic saline solution [27] and had a significant effect on the protrusive and laterotrusive mandibular excursions and the orientation in degrees of these excursions. Consequently, masseter muscle pain will probably influence the range of mandibular motion as also can be demonstrated with the pantographic reliability index [21, 22]. However, the effect of the masseter muscle pain on the anterior-posterior and the transverse position of the apex of the centric relation tracing ranged from 0.0 to 0.6 millimetre, a mean of 0.22 millimetre. As there were only 5 subjects [27] in that study and a power analysis is lacking, the suggested influence on centric relation seems to be more in line with the normal distribution in the reproducibility of a gothic arch tracing, which is less consistent than both chinpoint guidance or bimanual manipulation with a jig[17]. The normal distribution of the apex of a gothic arch tracing proved to be 0.94 millimetre anterior-posteriorly and 1.0 millimetre laterally in a sitting patient and 0.25 millimetre anterior-posteriorly and 0.48 millimetre in a supine patient [4].

Another, rather conspicuous result was found in the split-cast analysis of wax record sets A and B. In patients with a TMD diagnosis, the split-cast mounting of chinpoint guidance did not coincide with the leaf gauge position before treatment in the majority of the patients. Contrary to the control group, the null hypothesis for TMD patients must be rejected. The 2 methods to locate centric relation lead to a different position. However, after splint treatment both positions were coincident in most patients, which suggests that the TMD patients start to behave as control subjects. This finding again confirms the general opinion that the various techniques to locate centric relation result in the same position [3] in healthy individuals.

The fact that in some recent studies a stabilization splint is considered to be the most effective means [37,38] in the reduction of symptoms of musculoskeletal facial pain suggests that the significance of centric relation, at least as one determining factor, is more important than thus far believed and challenged. In clinical practice, reproducibility is a valuable tool to assess the validity of a centric relation [16] record. Validation of one of both reference positions in this study as the therapeutic position of choice for extensive restorative dentistry in general and for the fabrication of a stabilization splint in particular remains to be demonstrated in a future, randomized controlled clinical trial.

CONCLUSIONS

Chinpoint guidance and the muscle-determined technique with the leaf gauge are reliable methods to determine the maxillomandibular reference position centric relation in healthy individuals and in TMD patients.

In patients with a TMD diagnosis the chinpoint guided position differs from the stable orthopaedic centric relation position at baseline of splint treatment, compared to their coincidence at conclusion of treatment.

Since no difference exists in the accuracy of both methods to locate CR, the difference in the CR position in TMD patients before splint treatment must be attributed to the used bite force in the technique with the leaf gauge.

MANUFACTURERS DETAILS

- CA 37, Cavex, Haarlem, The Netherlands.
- Fuji Rock; GC, Leuven, Belgium.
- Axioquick; SAM-Co, Munich, Germany.
- Moyco Wax, Pink X-hard; Moyco, Philadelphia PA, USA.
- Huffmann's leaf gauge, Huffmann's Dental Products, Springfield OH, USA.

ACKNOWLEDGEMENTS

The authors wish to thank Drs. Ronald Cabri and Martijn C. Molenaar for their contribution as examiners to this study. The authors also wish to thank Dr. M.F. Land, DDS MSD, Dr. J.P. Okeson, DMD, Dr. A. van der Bilt, PhD and Prof. Dr. R. Koole, DDS PhD for their valuable remarks and advice.

This study was supported by a grant from the American Equilibration Society in 2002.

The study was presented at the EPA Conference in Prishtina, Kosovo, September 2010.

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