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The Incidence of Centric Slides in Healthy Individuals and TMD Patients

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Abstract - *Controversy exists as to whether centric slide is an etiological factor for temporomandibular disorders. In this cross-sectional study the magnitude of centric slides, obtained with 2 different articulations and one with a millimetre ruler was compared. The study enrolled a group of 27 healthy individuals and 83 TMD patients, the latter divided in 3 groups of 26, 28 and 29 subjects with the RDC/TMD diagnoses of myofascial pain, osteoarthritis and disc displacement without reduction, respectively. Measurement reliability of a chinpoint guided articulation was compared with a musculoskeletally stable articulation, obtained using a leaf gauge. Next, centric slide was measured, if any, intraorally with a millimetre ruler and in both articulations measuring the difference between centric relation and the maximal intercuspal position. A mandibular full-arch Tanner type stabilisation splint was fabricated for each of the TMD patients. After splint treatment, new casts were obtained and mounted using both methods to locate centric relation. The magnitude of centric slide intraorally and in both articulations was reassessed. For the analysis of the variables a mixed-model procedure was applied (α=0.05). At baseline and upon conclusion of splint treatment all groups exhibited centric slides with large standard deviations (ranging from 1.03 ± 0.83 to 1.97 ± 1.3 millimetre). In the mixed-model procedure a significant difference in magnitude existed between the millimetre ruler and both the chinpoint guidance as well as the leaf gauge articulation ($P<0.001$). No correlation between centric slide and TMD could be demonstrated.*

KEY WORDS: Centric relation, centric slide, TMD

INTRODUCTION

Centric slide has been defined in the eighth edition of Glossary of Prosthodontic Terms (GPT-8), as the movement of the mandible while in centric relation, from the initial occlusal contact into maximum intercuspation [1], the maximal intercuspal position (ICP). This initial occlusal contact is referred to as the retruded contact position (RCP) and considered synonymous to the first contact in centric relation [1]. Therefore, centric slide may be designated as an RCP-ICP slide. The term RCP may be confusing since in the beginning the retruded position was defined as that guided occlusal relationship occurring at the most retruded position of the condyles in the joint cavities, synonymous to the ligamentous position [2] and possibly more retruded than centric relation (GPT-4) [1]. Some consider the terms 'retruded' and 'most posterior' obsolete[3]. More recently, the term centric relation contact position has been introduced [3].

The presence of RCP-ICP slides can be detected when moderate posterior pressure is exerted on the chin and the mandible is manipulated around a virtual axis to the initial tooth contact [4]. If a slide is present, the mandible moves from this first contact in RCP anteriorly and/or laterally to ICP. Centric slide is also the anterior-posterior discrepancy manipulating the mandible into the musculoskeletally stable centric relation position and bringing, with a hinge-type movement, the teeth into light contact [5]. Okeson suggested that the musculoskeletally stable centric relation position can only be determined with bimanual manipulation, with a jig or a leaf gauge [5]. Centric slide may result from the occlusion, the joints, or both [5]. Joint instability may be related to alterations in the normal anatomic form, such as in a disc displacement or an arthritic condition [5]. Prolonged clenching may lead to disc displacement, possibly as a result of splinting of the lateral pterygoid muscle [6]. Harmful occlusal interferences or premature contacts may prevent the condyle being seated on the disc, lead to centric slide and some considered them the cause of bruxism and/or temporomandibular disorders [7]. Occlusal adjustment has been recommended as treatment to eliminate the RCP-ICP slide as a preventive and/or a treatment means [7].

In a descriptive survey of a large student population, asymmetrical slides larger than 1 millimetre were found to be related to dysfunction, characterized by temporomandibular joint (TMJ) tenderness and dull occlusal sounds [4]. In an epidemiological survey among healthy individuals ranging in age from 20 to 40 years, 90% of the slides were 0 (21%) or less than 1 millimetre (69%) [8]. The remaining 10% were larger than 1 millimetre. Asymmetrical RCP-ICP slides > 1 millimetre showed the most TMJ tenderness. In a clinical controlled study, centric slide, as a univariate occlusal factor, was demonstrated to be an etiological factor [9], largely expressed as muscle signs of TMD, although not correlated with any specific TMD diagnosis. From a contemporary study [10] it has been demonstrated that slides larger than 2 millimetre were observed in patient groups with disc displacement and osteoarthritis/-osis. In a multiple logistic regression model occlusal variables explained at most 4.8 to 27.1% of the various TMD diagnoses.

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At first, occlusal adjustment was proposed to eliminate deflective occlusal contacts, consequently the centric slide, in particular by Clark and collegues [11]. Occlusal adjustment [7, 11] was supposed to prevent the development of TMD. However, a systematic review [12] concluded that there is no evidence of efficacy of occlusal adjustment and that occlusal adjustment should not be recommended for either treatment or prevention of TMD. It is not possible to draw any etiological conclusions from prevalence based models; occlusal variation, specifically, the presence of a centric slide, may be a consequence rather than a cause of TMD [10].

Centric slides occurs in 90% of all dentitions, measuring 1.25 millimetre on average [3] and are considered to be a normal distribution of functional adaptation. The presence of a centric slide is relatively easy to observe clinically [3], can be measured with a millimetre ruler [4], but for a more accurate evaluation of its magnitude occlusal analysis on articulator-mounted casts is necessary [3]. The purpose of this study was to compare centric slide, measured intraorally with a millimetre ruler with the centric slide in articulator mounted casts. Four groups were evaluated: healthy individuals, and patients with 3 different TMD diagnoses: myofascial pain, disc displacement without reduction and osteoarthritis. Simultaneously, the magnitude of centric slides measured after chinpoint guided centric relation articulation were compared with those measured using a musculoskeletally stable centric relation articulation, obtained using a leaf gauge technique. The null hypothesis was formulated that there are no differences between the magnitude of the slides, obtained with the millimetre ruler and both CR articulations, in healthy individuals and in TMD patients before and after stabilization splint treatment.

MATERIAL AND METHODS

The original study [13] was conducted to test reproducibility of 2 methods to locate centric relation: chinpoint guided centric relation and musculoskeletally stable centric relation, obtained with a leaf gauge, in 27 control and 91 TMD patients. Attrition of this study was 8 TMD patients. Consequently, the current study enrolled a group of 27 healthy individuals and 83 TMD patients, divided in 3 groups of 26, 28 and 29 subjects with the RDC/TMD [14] diagnosis myofascial pain (MYO), osteoarthritis (OA), and disc displacement without reduction (ID) respectively. The study design is presented in figure 1. Based on a power analysis conducted in a previous study [15], the minimally required number of participants was calculated to be at least 26 subjects per group to determine statistical significance for a 95% confidence interval. 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. A quick-mount procedure consists of impressions of the mandibular and the maxillary arch, poured in Class IV stone, mounted to an articulator with a face bow registration and a centric relation record. 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 [13].

The study was blinded and controlled using 1 investigator and 2 independent examiners. The principal investigator examined all patients and control subjects and allocated them to the appropriate diagnostic group. Two calibrated

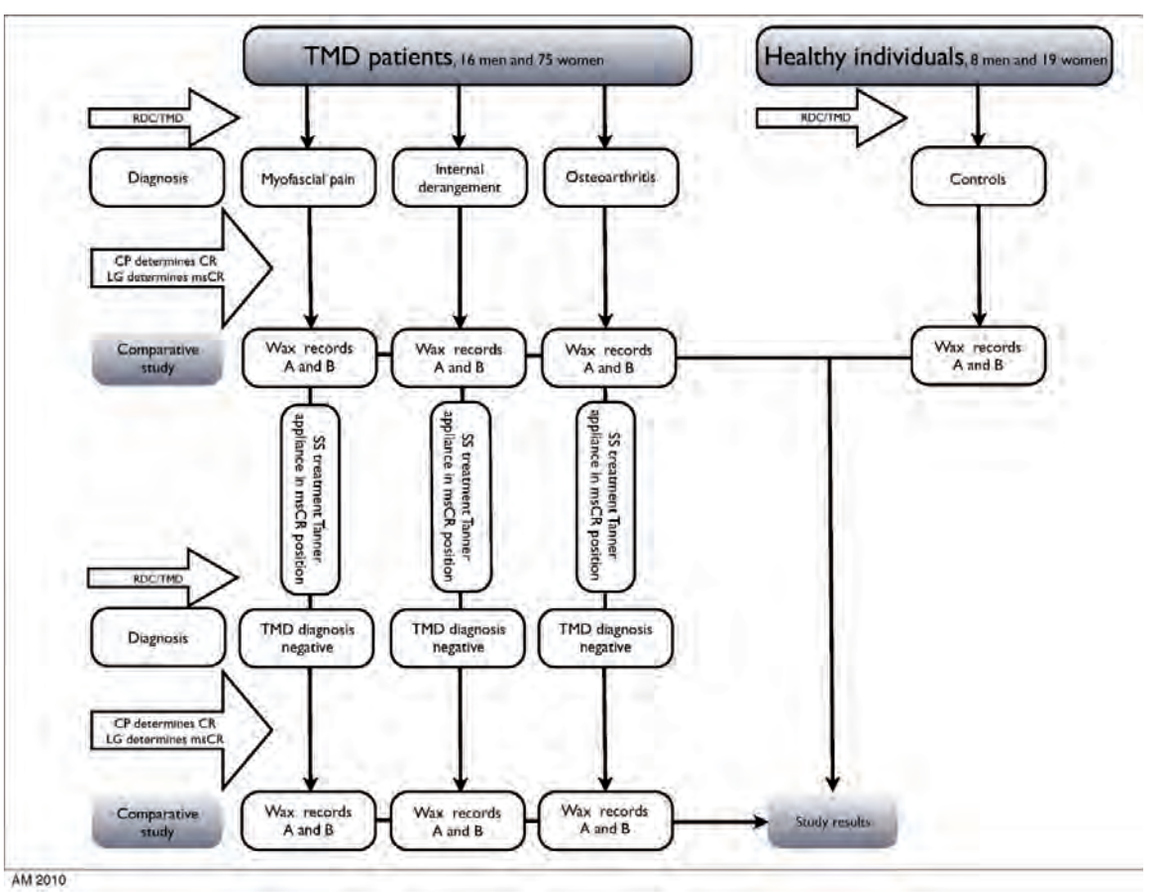

Figure 1. *Study design. CP = chinpoint guidance, CR = centric relation, LG = leaf gauge, msCR = musculoskeletally stable centric relation.*

examiners, X and Y, prepared 2 identical sets of 3 interocclusal wax records that were labelled A 1 - 3 and B 1 – 3 (Moyco Wax, Pink X-hard). The examiners made sequential centric relation records for a mounting procedure. Wax record A1 and B1 were used to mount mandibular casts A and B respectively to a maxillary cast that was oriented by means of a face-bow transfer (Axioquick; SAM-Co) to the articulator (SAM 2P; SAM-Co). Next centric slide was measured intraorally with a millimetre ruler [4] and noted in the patient record. The principal investigator performed an instrumental analysis with a split-cast procedure and subsequent measurements in a Condymeter (Condymeter III; SAM-Co). The results of the reproducibility study have been previously reported [13]. Next, the magnitude of the centric slide was measured on both articulations and recorded.

Subsequent to these measurements a Tanner type stabilization splint was fabricated for each of the TMD patients, using the leaf gauge articulations. A Tanner appliance is a mandibular complete arch, full-coverage, heat-cured acrylic splint with cuspid-to-cuspid anterior guidance and the maxillary, lingual cusps in contact with the appliance [13]. 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 disorder 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 13. Next, a second mounting procedure was initiated to test reproducibility of the 2 methods to locate centric relation and to reassess the magnitude of any residual centric slide after splint treatment.

On an articulator, the centric slide can be measured by taking Pythagoras' hypotenuse from the horizontal displacement on the incisal table and the vertical displacement along the incisal pin. The SAM articulator system (SAM-Co) provides a millimetre loupe and an incisal pin, each with a measuring range of 10 millimetres, the latter subdivided in increments of 0.1 millimetre (Fig. 2 A and B.). For the analysis of the variables a mixed-model procedure was used (SAS/STAT, version 9, SAS Institute. Cary, NC).

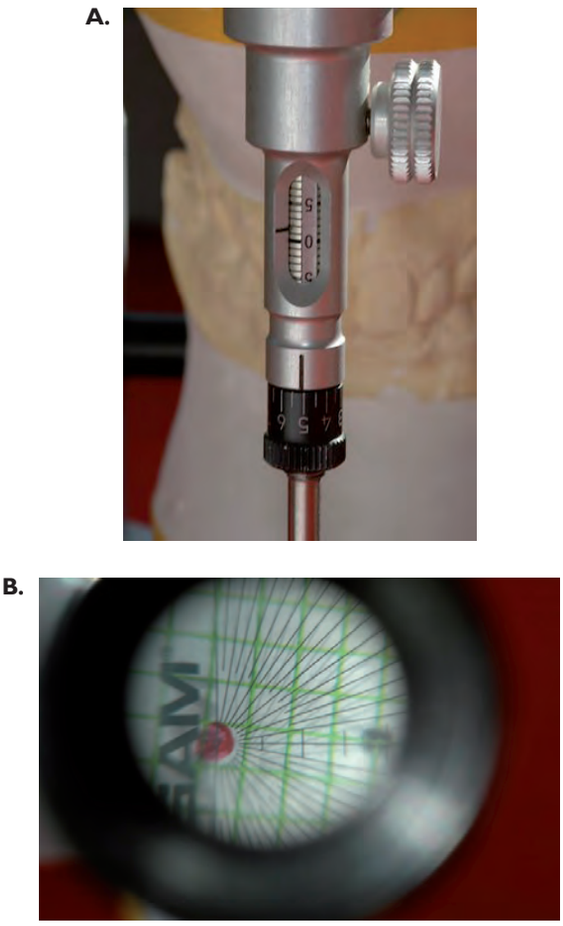

Figure 2.

RESULTS

In the ID group of the current study centric slide of 1 patient was not measurable accurately as a result of her extreme Class II division 2 maxillomandibular relationship. Estimates for pooled mean values and standard deviations of centric slide in the patient groups, before and after SS treatment and in the control group are presented in table I. Centric slide ranged from 1.04 millimetre in the OA group of the chinpoint guidance articulation to 1.76 millimetre in the ID group of the leaf gauge articulation (Table I). All mean values of centric slides of the control and the 3 patient groups, before as well as after splint treatment, showed a relatively large range and standard deviation (Table I). The mean centric slide in healthy controls, the MYO and the OA group was similar. Splint treatment did not influence the magnitude of the slide in the MYO and OA groups. Splint treatment increased the magnitude of the slide in the ID group but both articulations, before and after splint treatment, reveal a large standard deviation (Table I). However, the increase in magnitude was not statistically significant (Table II, P=0.053).

A mixed model was applied to test the random factor patients with the fixed factors method, patient group, point in time, before and after SS treatment. The applied model revealed no significant differences in point in time (Table II), before and after splint treatment (P=0.48). In a next analysis control subjects were added to the mixed model. Testing for differences between the control group, 3 patient groups and 3 methods (Table III) only revealed a significant difference in the methods (P<0.001). This significant difference in the magnitude of centric slide existed between the millimetre ruler and chinpoint guidance, as well as with the leaf gauge articulation (Table IV).

DISCUSSION

As reported previously [3] a significant difference in magnitude existed between the millimetre ruler and the articulations (P<.001). No significant difference was demonstrated between the 2 methods of articulation. A millimetre ruler

Table 1. *Pooled mean values, standard deviation and range of the distribution of centric slide pre and post SS treatment in 3 patient groups with a TMD diagnosis and single values in healthy control subjects. ID = disc displacement without reduction, MYO = masticatory muscle disorder, OA = osteoarthritis.*

In mm	*Method*											
Group	*Millimetre ruler*				*CP articulation*				*LG articulation*			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Control	0.17	0.41	0.00	1.50	1.21	1.26	0.00	4.64	1.34	0.93	0.00	3.04
ID	0.50	0.64	0.00	2.50	1.54	1.21	0.00	5.06	1.76	1.27	0.03	5.32
MYO	0.40	0.64	0.00	2.25	1.19	0.93	0.10	3.58	1.28	0.96	0.11	3.14
OA	0.25	0.50	0.00	1.75	1.04	0.70	0.00	2.84	1.27	0.88	0.08	3.26

Table 2. *Mixed model procedure with the fixed factors method, patient group, point in time, before and after SS treatment and the random factor patients. ID = disc displacement without reduction, MYO = masticatory muscle disorder, OA = osteoarthritis.*

Source of variation	*method*	*diagnosis*	*time*	*Mean*	*P*
method	chinpoint guidance			1.24	<.001
method	millimetre ruler			0.38	
method	leaf gauge			1.43	
point in time			1	0.99	0.48
point in time			2	1.05	
diagnosis		ID		1.26	0.053
diagnosis		MYO		0.95	
diagnosis		OA		0.85	

Table 3. *Mixed model procedure with the fixed factors method and patient group and the random factor patients. CON = control, ID = disc displacement without reduction, MYO = masticatory muscle disorder, OA = osteoarthritis.*

Source of variation	*method*	*diagnosis*	*Mean*	*P*
method	chinpoint guidance		1.22	<.001
method	millimetre ruler		037	
method	leaf gauge		1.33	
diagnosis		CON	0.90	0.41
diagnosis		ID	1.18	
diagnosis		MYO	0.93	
diagnosis		OA	0.87	

Table 4. *Mixed model procedure with the fixed factor method and the random factor patients.*

Effect	*method*		*Mean*	*SE*	*df*	*t Value*	*P*
method	chinpoint guidance	millimetre ruler	0.85	0.11	216	7.73	<.001
method	chinpoint guidance	leaf gauge	-0.10	0.11	216	-0.96	0.33
method	leaf gauge	millimetre ruler	0.95	0.11	216	8.96	<.001

was less accurate than either of the articulations. Therefore, the null hypothesis must be rejected. The millimetre ruler is a one-dimensional measurement in the sagittal plane between the first contact in centric relation and the maximal intercuspal position; the articulator provides a measurable 3-dimensional mandibular displacement. The ruler is divided in millimetre increments, the loupe provides magnified millimetre increments and the incisal pin has increments of 0.1 millimetre (Fig. 2 A and B). These results are in line with a previously reported study [3].

There is a large range in the magnitude of centric slide within healthy control subjects and TMD patients. The distribution of centric slide within the pain diagnoses myofascial pain and osteoarthritis, at baseline and at conclusion of splint treatment, and the control group is similar. Whilst there was a larger larger value for the magnitude of centric slide in the ID group relating to the splint treatment this was not statistically different (P=0.41, Table III). There was a large standard deviations and, consequently a substantial overlap of the data between the other groups

and the ID group. Centric slides in the OA group were the smallest (1.04 mm) and in the ID the largest (1.76 mm). Some authors suggest that patients with osteoarthritis/-osis remodelling of the temporomandibular joint may develop a larger slide [10]. However, in the current study, disc displacement without reduction revealed the largest slide, possibly a matter of definition and presumably as a result from splinting of the lateral pterygoid muscle [5, 6]. Clenching may lead to disc displacement [6], activating the lateral pterygoid muscle to pull the disc out of the friction area and prevent damage. The prolonged contraction of the lateral pterygoid muscle may lead to a spasm, a phenomenon usually observed in disc displacement without reduction. [5] The magnitude of the centric slides exhibited by the healthy control subjects is well within the range of the slides found in the TMD patients. Therefore, the problem in modelling occlusal variables to differentiate TMD patients from healthy control subjects remains the overlap between most TMD patients and healthy individuals [10], as demonstrated by the large ranges and standard deviations in the present study. In the current study centric slide is not associated with a specific temporomandibular disorder, suggesting that centric slide and TMD are separate entities and probably unrelated.

Disc displacement without reduction may be partly accountable for the 4.8 to 27.1% [10] where occlusal factors are an etiological factor for this specific TMD diagnosis. In the present study the variable 'centric slide' does not necessarily have the same power [15] as the variable 'reproducibility of centric relation' does [13]. Recruiting a greater number of patients thus increasing the power may lead to the demonstration of a significant difference in the centric slides between the disc displacement group compared to the control and the 2 other groups (Table II, P=0.0538). The ID group shows the largest centric slide in the present study and its increase in magnitude may explain the ID group patients' symptom 'my bite is off".

In conclusion this study supports the theory of the adaptation demand model [10] of the temporomandibular joint. This model explains that more extreme biological variation, for example extreme occlusal factors may impose a greater adaptation demand upon a multifactorial system as the temporomandibular joint to maintain its normal function [10]. Centric slide probably is a consequence rather than a cause of TMD. Therefore, occlusal adjustment to eliminate the slide [11] is not an option for treatment of a temporomandibular disorder. This outcome is confirmed in recent literature [12].

CONCLUSIONS

Within the limitations of this study the following conclusions were drawn:

- No relationship was demonstrated between centric slide and temporomandibular disorders in this study.
- Centric slides were equally distributed between healthy control subjects and patients with selected TMD diagnoses.
- The millimetre ruler appeared to be an unreliable instrument to measure centric slide intraorally.

MANUFACTURERS DETAILS

- Moyco Wax, Pink X-hard; Moyco, Philadelphia PA, USA.
- Axioquick; SAM-Co, Munich, Germany.
- SAM 2P; SAM-Co, Munich, Germany.
- Condymeter III; SAM-Co, Munich, Germany.

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