ABSTRACT: Centric relation (CR) has been considered a maxillomandibular position of choice for some dental and prosthetic procedures. Although regarded as a fully reproducible relation, there is great controversy about its clinical use and recording technique, especially in patients with signs and symptoms of temporomandibular disorders (TMD). This study aimed at evaluating the effectiveness of a training program on intra- and interexaminer agreement when determining the clinical record of the CR position. Forty individuals constituted the sample, divided into symptomatic (TMD) and asymptomatic groups. Three previously calibrated examiners performed the initial assessment and the second evaluation after 30 days in a blind design, using Dawson’s bilateral manipulation technique with and without an anterior stop. The amount of frontal and sagittal deviations in relation to intercuspal position, the presence of pain and discomfort during manipulation, and the first occlusal contact in CR were analyzed. Kendall and Kappa tests with a 5% level of significance were used to determine agreement. Values for both intra- and interexaminer agreement were deemed good. The best results were obtained for frontal deviations and assessment of pain (or absence of it) during manipulation. Sagittal deviations showed the lowest agreement in both examinations. The authors concluded that a calibration program could be effective for intra- and interexaminer agreement when recording centric relation. However, caution is recommended when analyzing some isolated items.

DESCRIPTORS: Centric relation; Temporomandibular joint disorders.

INTRODUCTION

The concept of centric relation (CR) was introduced in dentistry with a view to reproduce the mandibular position during the fabrication of dentures, therefore providing conditions for complete dentures to develop all their functions in harmony with the other components of the stomatognathic system.

One of the first reports on CR was made by Gysi, in 1910, who presented the gothic arch tracing technique for achieving this position, initia-
ting a new phase in dentistry. After this study, dif- 
ferent concepts have appeared about this occlusal 
relationship, which were altered according to opi- 
nions from that time period. The current concept 
of CR most accepted by the scientific community 
was provided by the 7th edition of the “Glossary of 
Prosthetic Terms” (1999), as follows: “the maxillo-
mandibular relationship in which the condyles ar-
ticulate with the medial portion of their respective 
disks, being this complex (disk-condyle) in an an-
tero-superior position against the surface of the 
articular eminence”. When employed for prosthetic 
reconstructions, this is a suitable position because 
of its reproducibility. One review of the reproduc-
tion techniques reveals that most of them (inclu-
ding the bilateral manipulation, the chin point gui-
dance, the Lucia jig or the laminated calibrator) 
are able to achieve a consistent condylar position 
in nearly all patients. Yet, some studies have de-
monstrated that the precision of most of these 
techniques is severely limited in the presence of 
temporomandibular disorders.

Several studies addressing the reproducibility 
of CR have related small variations in the condylar 
position between several CR recordings. Despite of its reproducibility, there is a millimetric 
variation, i.e. an accurate achievement of CR re-
cording is not always feasible.

Some evidence suggests that the CR position 
may vary with time and with the different record-
ing methods. Moreover, several factors may influ-
ence its registration, such as emotional stress, 
TMJ and facial muscle pain, neuromuscular con-
ditioning, manipulation technique or operator’s 
guidance. On this basis, the need to evaluate the 
reproducibility of CR is highlighted.

The present study aimed at evaluating the in-
tra- and interexaminer agreement in the analysis 
of CR position, comparing these findings in 
asymptomatic individuals and patients with TMJ 
internal derangements.

MATERIAL AND METHODS

The present study comprised a sample of 40 in-
dividuals, divided into 2 groups (asymptomatic 
and symptomatic patients). Group I (asympto-
tic) included 20 individuals equally distributed 
between genders, which were randomly selected 
from the dental clinics, School of Dentistry of Bau-
ru (FOB/USP). These patients presented no signs 
and symptoms of TMD.

Group II (symptomatic) consisted of 20 indi-
viduals equally distributed between genders present-
ing with signs and symptoms of arthrogenic TMD. 
All these patients were randomly selected from the 
individuals attending the TMD and Orofacial Pain 
Center, Department of Prosthodontics (FOB/USP).

Inclusion criteria for this group was accomplished 
after anamnesis and detailed physical examinati-
on, comprising muscle and TMJ palpation, evalua-
tion of the mandibular movement and inspection 
of joint sounds.

The individuals received information on the ob-
jectives of the research, and, after all procedures 
had been fully explained, they signed an informed 
consent term, in agreement with Regulation 
196/96 of the Brazilian National Health Council.

The examiners were trained to perform the ma-
nipulation technique and the CR recording met-
 hod. For that purpose, the research coordinator 
demonstrated the technique and subsequently the 
three examiners carried out the same procedure in 
four dental students, simulating the study evalua-
tion.

The bilateral manipulation technique suggested 
by Dawson was selected, with or without an anteri-
or stop.

Manipulation of the patients was initially per-
formed with no anterior stop. During manipula-
tion, the examiners identified the first centric den-
cial contact, by means of an articulating paper 
(AccuFilm II, USA). Vertical and sagittal deviations 
were also recorded in a standardized form, as well 
as the report of pain or discomfort upon manipula-
tion. Afterwards, a cotton roll was placed between 
the incisors for 5 minutes to act as a stop, in order 
to eliminate occlusal contact and mechanorecepti-
on of the periodontal ligament. After this period, 
the same procedures were repeated in an attempt 
to verify the influence of the stop on the CR recor-
ding.

The groups of 10 patients evaluated in each ses-
sion always comprised 5 asymptomatic and 5 
symptomatic individuals, who were randomly eva-
luated. Yet, examiners were blinded to group dis-
tribution.

The study variables were described as percenta-
ges. The Kendall test of concordance evaluated in-
terexaminer agreement, whereas intraexaminer 
agreement was analyzed through the Cohen’s Kap-
pa test. A significance level of 5% was selected for
both. The Kappa (K) and Kendall (W) values are interpreted as follows: from 0 to 0.20 - poor agreement; from 0.21 to 0.40 - regular; from 0.41 to 0.60 - moderate; from 0.61 to 0.80 - satisfactory; and from 0.81 to 1.00 - excellent.

RESULTS

Tables 1 and 2 demonstrate the results of interexaminer agreement of the 1st and 2nd evaluations for the different study variables, according to the Kendall test.

DISCUSSION

The literature on interexaminer agreement for the clinical evaluation of CR reproducibility is quite large. Previous studies\(^\text{3,6,7,24}\) have focused on the interexaminer agreement for evaluation of caries, signs and symptoms of periodontal disease and radiographic examinations. All these studies have employed relatively objective data, such as pocket probing depth, bone loss and presence or absence of caries, whereas standardization of CR manipulation is based on less objective data.

### Tables

**TABLE 1** - Agreement value (W) for the study variables between the different examiners (interexaminer analysis), with no distinction of group (symptomatic or asymptomatic) – 1st and 2nd evaluation (Kendall test).

<table>
<thead>
<tr>
<th>Evaluated item</th>
<th>1st evaluation</th>
<th>2nd evaluation</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontic class</td>
<td>W: 0.69</td>
<td>W: 0.60</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Frontal deviation (WOAS)</td>
<td>W: 0.73</td>
<td>W: 0.70</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sagittal deviation (WOAS)</td>
<td>W: 0.50</td>
<td>W: 0.62</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Report of pain during manipulation (WOAS)</td>
<td>W: 0.87</td>
<td>W: 0.78</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>1st contact (WOAS)</td>
<td>W: 0.72</td>
<td>W: 0.74</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Frontal deviation (WAS)</td>
<td>W: 0.63</td>
<td>W: 0.73</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Sagittal deviation (WAS)</td>
<td>W: 0.53</td>
<td>W: 0.66</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Report of pain during manipulation (WAS)</td>
<td>W: 0.88</td>
<td>W: 0.90</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>1st contact (WAS)</td>
<td>W: 0.66</td>
<td>W: 0.83</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

WOAS: without anterior stop; WAS: with anterior stop.

**TABLE 2** - Agreement value (W) for the study variables between the different examiners (interexaminer analysis), with distinction between symptomatic (I) and asymptomatic (II) groups.

<table>
<thead>
<tr>
<th>Evaluated item</th>
<th>Group I</th>
<th>Group II</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthodontic class</td>
<td>W (I): 0.81</td>
<td>W (II): 0.53</td>
<td>0.056</td>
</tr>
<tr>
<td>Frontal deviation (WOAS)</td>
<td>W (I): 0.73</td>
<td>W (II): 0.71</td>
<td>0.005</td>
</tr>
<tr>
<td>Sagittal deviation (WOAS)</td>
<td>W (I): 0.36</td>
<td>W (II): 0.61</td>
<td>0.019</td>
</tr>
<tr>
<td>Report of pain during manipulation (WOAS)</td>
<td>W (I): 0.74</td>
<td>W (II): 0.81</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>1st contact (WOAS)</td>
<td>W (I): 0.66</td>
<td>W (II): 0.81</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Frontal deviation (WAS)</td>
<td>W (I): 0.70</td>
<td>W (II): 0.57</td>
<td>0.036</td>
</tr>
<tr>
<td>Sagittal deviation (WAS)</td>
<td>W (I): 0.39</td>
<td>W (II): 0.63</td>
<td>0.015</td>
</tr>
<tr>
<td>Report of pain during manipulation (WAS)</td>
<td>W (I): 0.33</td>
<td>W (II): 0.85</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>1st contact (WAS)</td>
<td>W (I): 0.71</td>
<td>W (II): 0.57</td>
<td>0.032</td>
</tr>
</tbody>
</table>

WOAS: without anterior stop; WAS: with anterior stop.
The literature unanimously states that standardizing the examination is paramount to assure reliability of the information obtained.

The interexaminer evaluations performed in the present study demonstrated a satisfactory agreement for most study variables: 0.645 (orthodontic class), 0.715 (frontal deviation without anterior stop - FDWOAS), 0.730 (contact WOAS), 0.65 (frontal deviation with anterior stop - FDWAS), 0.745 (contact WAS). Results were excellent for the items report of pain WOAS (0.825) and report of pain WAS (0.896), therefore demonstrating the importance of calibration procedures before examiners initiate the evaluations.

The statistical outcomes in Table 1 (1st and 2nd interexaminer evaluations) revealed that the sagittal deviations without anterior stop (SDWOAS) and sagittal deviation with anterior stop (SDWAS) demonstrated the lowest agreement levels (0.50 and 0.53 at the 1st evaluation, and 0.62 and 0.66 at the 2nd evaluation, respectively). A small percentage of individuals presented coincident CR and intercuspal (IC) positions. A much higher percentage of individuals have a difference of 0.1 to 1.5 mm between CR and IC. The discrepancy between both positions, commonly named centric slide or centric discrepancy, may occur in all three planes of the space and is estimated to be 0.1 to 1.5 mm in the vertical direction, 0.1 to 1.0 mm in the horizontal direction and smaller than 1.0 mm in the transverse direction. This small variability of sagittal displacement observed in the literature, combined to the difficulty experienced by examiners upon measuring, has influenced the agreement levels. The difficulty to evaluate the discrepancy is transmitted to the judgment form itself, in which differences below 0.5 mm may yield disagreement between examiners (IC = CR; up to 1.0 mm; and higher than 1.0 mm).

In the present study, the report of possible pain during manipulation in symptomatic patients demonstrated an optimal agreement, possibly due to the fact that most patients in this group had a complaint of pain during manipulation, thus simplifying analysis of this item by the examiners and therefore increasing the agreement level. According to Harper, Schneidemen (1996), the determination of the condylar hinge axis with the condyle in CR was more reproducible in patients with TMJ internal derangement than in asymptomatic patients. This might be the outcome of the anatomic obstruction of a displaced disk without reduction or the presence of adherences of TMJ, limiting the condylar position during the translation phase. The present study, however, did not evaluate disc displacement without reduction patients.

Regarding the manipulation technique suggested by Dawson (1996), employed in the present study, there are three possible reasons for the occurrence of pain in patients when firm pressure is applied: bad positioning of the condyle, improper alignment between the condyle and its disk, and joint pathology.

Many other factors influencing the CR recording are also observed in the literature, including physical or emotional stress, pain affecting the TMJ and other components of the masticatory system, neuromuscular conditioning, manipulation or guidance of the operator, soft tissue alterations, different examiners and different recording methods.

Some evidence suggests that the CR position may vary with time and the different periods of the day. Latta (1992) reported that recordings in edentulous patients demonstrated differences in the condylar position throughout the day as high as 2.63 mm. Shafagh et al. (1975) reported that different outcomes were observed when the CR recordings were performed in dentate patients at day and at night, probably due to the daily variation of shape and synovial fluid.

During CR recording in this study, after placement of the anterior stop, the examiners reported an easier manipulation when compared to the recording without anterior stop, although no significant difference was detected. According to Mezzomo, Frasca (1996), depending on the intensity of pain and the degree of muscle hyperactivity, manipulation of the mandible aiming at reaching CR is difficult at first. Thus, allowing the patient to rest for 10 to 15 minutes with no dental contact may be helpful for neuromuscular deprogramming. As previously mentioned, this procedure may increase agreement, yet it did not yield any significant differences in the present study.

It is important to distinguish between the two types of agreement evaluation: one refers to the reliability of each examiner when performing the same task different times (intraexaminer), while the other indicates whether this same reliability also exists between examiners when observing the same variable in the same patient (interexaminer).

Concerning interexaminer evaluation with distinction between groups (Table 2), in general the
agreement levels were not very similar. Yet, this study did not aim to discuss the validity of the clinical employment of CR as a therapy for TMJ pathosis. It is known that TMJ internal derangements may cause the joint structure to become more sensitive to alterations in condylar position. The items sagittal deviation (with or without anterior stop) presented the same agreement levels, maybe because of the more difficult observation, since this analysis was performed through lateral visualization of the posteroanterior slide of the mandible when assuming the intercuspation position. This smaller agreement points toward the need to be careful when this item is regarded alone as the parameter for comparison between groups.

Except for the items sagittal deviation with and without anterior stop, especially in asymptomatic patients, and for the possible report of pain during manipulation, no detectable statistical differences were found between groups I (asymptomatic) and II (symptomatic).

As regards the intraexaminer evaluation (Table 3), the agreement levels were generally smaller than the interexaminer values, suggesting the possibility that the time period of one month between the first and second evaluations may have affected the accuracy of the manipulation technique and observation of the study items for all three examiners, which is in agreement with previous studies.

In spite of the relatively poor agreement, the frontal deviation revealed an even intraexaminer agreement for the three examiners. This noticeably lower level of agreement for the item sagittal deviation for both intra- and interexaminer evaluations possibly demonstrates the more difficult observation of such item by the examiners. Thus, it may be stated that the calibration program was effective for the achievement of agreement between examiners. Yet, after one month, these values were reduced, even though still maintaining acceptable levels. This difference may probably have occurred due to natural alterations affecting the joint structures, related to the synovial fluid, disk shape and muscular condition. This also leads us to question the adoption of CR as a rigid position, absolutely required for stomatognthic health. The difficulty to judge some important items and the report of pain in patients with TMD may suggest that this position might just be an initial guide for extensive prosthetic and occlusal procedures, yet being highly susceptible to individual variation.

**CONCLUSIONS**

Considering the results obtained in the present study, it can be concluded that:

1. The training and calibration programs demonstrated to be efficient for the achievement of interexaminer agreement in CR recording.
2. The main difficulty experienced by the examiners was related to sagittal deviation, which consequently demonstrated the lowest agreement values.
3. Time and the physiological variation of the stomatognthic system led to a lower level of intraexaminer agreement.
4. Patients presenting with temporomandibular dysfunctions do not present differences in the reproducibility of CR position when compared to normal patients.

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