

Recording of the retruded position of the mandible in patients with mandibular dysfunction

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The precision (reproducibility) of active and passive recordings of the retruded position of the mandible was studied by two examiners on 10 patients with mandibular dysfunction symptoms. The position of the mandible was recorded with an intra-oral graphic method, before and after treatment of the symptoms. The precision of the recording was highest when the retruded position was recorded by passive hinge movement and lowest when it was recorded by active hinge movement and when recording habitual closure. Both systematical and accidental errors tended to be somewhat larger among these patients than that previously found among individuals without signs or symptoms of mandibular dysfunction. The accidental errors in antero-posterior and medio-lateral directions were the same for both examiners and of the same magnitude before and after treatment of the symptoms.

Both examiners recorded the retruded position on the average 0.20 mm more posterior after treatment than before. The results showed that because of its good reproducibility the retruded position of the mandible can be recommended as a reference position in functional analysis of occlusion and for jaw recordings also in patients with TMJ muscle-pain dysfunction symptoms. During the recording the conventional technique with passive hinge movement and a posterior pressure should be used.

Key-words: Temporomandibular joint syndrome; jaw recordings

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In comparison with other methods for recording of the retruded position of the mandible, passive recording of the terminal hinge movement with a strong posterior pressure has shown the best precision (4, 5, 7). Application of a strong posterior pressure to a relaxed (passive) mandible also gives significantly more distal jaw positions than light pressures (2, 7).

Other authors (8, 11) have, however, recommended not to use a strong pressure because they fear it might elicit a protective muscle reflex with mandibular protrusion as a result. In the studies referred to above, using a strong distal pressure, no measurable effects of such muscular activity was observed. These studies were, however, performed on young adults with a healthy state

of the masticatory system. It cannot be excluded that individuals with mandibular dysfunction symptoms might react in a different way during the recording. Individuals with pain from the masticatory muscles or the temporomandibular joints might try to protect themselves against a distal pressure by "muscle splinting".

It has also been claimed that patients with mandibular dysfunction symptoms cannot relax their jaw muscles enough to secure an accurate recording of centric relation. For this reason some authors (1) even recommend a general use of bitesplints on *all* patients in need of occlusal therapy at least 24 hours prior to securing jaw registrations.

The purpose of this study was to elucidate if the method that has been proved to be the most precise for recording of the retruded position in individuals with a healthy masticatory system is also suitable for individuals with mandibular dysfunction symptoms and to elucidate if the retruded position of the mandible varies before and after treatment of the symptoms.

MATERIAL AND METHODS

The material consisted of 10 patients (3 males and 7 females) aged 19–55 years (mean age = 37.7 years). The patients were referred from dentists and medical doctors to the Department of Stomatognathic Physiology, Faculty of Odontology at the University of Göteborg, for treatment of symptoms of pain and dysfunction of the masticatory system.

All the patients except one had a full set of natural teeth. The exception had a bilateral free-end partial denture in the lower jaw. Balancing side interferences and interferences between the retruded position and intercuspal position were present in all the patients.

The subjective symptoms and the clinical findings as well as the patients' own evalua-

tion of their symptoms according to a 5-graded scale of severity are presented in Table 1 and 2. The patients were grouped according to the criteria of the anamnestic and clinical dysfunction indices as previously described by *Helkimo* (3). To be included in the study all patients must have at least one severe subjective symptom (A_iII) and one or more severe clinical signs of dysfunction i.e. at least dysfunction index II.

Treatment was initiated after the first recording session. Every patient got a bite splint of the stabilizing type in the upper jaw (9). Occlusal interferences were eliminated after the first recording. The occlusal adjustment was minor and selective. Relaxing movement exercises were also recommended to two patients. The second recording (Occasion II) was performed within 6 months after the first recording (Occasion I). The interval between the two recording occasions was on the average 111 days (range 30–180 days).

All the patients experienced subjectively an improvement of their symptoms on Occasion II, although it was very moderate for two individuals (no or only one step up on the scale). Eight individuals felt a considerable improvement of which 4 regarded themselves as completely symptom free and 4 felt only very light persisting symptoms (Table 1).

The anamnestic dysfunction index was reduced from II to I or 0 in all the patients except two, who reported the symptoms equally pronounced on both recording sessions.

The clinical examination revealed that 6 persons were almost completely symptom free (D_iI , 1–3p) on Occasion II. In 4 individuals, however, symptoms of the same degree of severity were recorded on both occasions.

Recording procedures

The jaw recordings were made utilizing an intra-oral graphic technique previously de-

Table 1. Age and sex distribution of the material and symptoms of mandibular dysfunction according to the anamnestic examination (interview). A_i = anamnestic dysfunction index (0 = absence of symptoms; I = moderate symptoms; II = severe symptoms). S_i = the patients' own (subjective) evaluation of the severity of their chief complaint according to a 5-graded scale of severity (1 = no or negligible, 2 = slight, 3 = moderate, 4 = severe and 5 = very severe symptoms)

Patient	Age	Sex	Fatigue/ Stiffness	TMJ- sounds	Pain/ Ache	Pain on movement	Reduced mobility	Bruxism	Head- aches	Occasion I		Occasion II	
										A_i	S_i	A_i	S_i
1	46	F				X	X	X	X	II	3	I	1
2	24	F	X		X			X	X	II	4	II	3
3	24	M			X	X	X			II	4	0	1
4	51	M	X	X	X			X		II	4	I	1
5	50	M			X	X			X	II	3	0	1
6	42	F	X	X			X		X	II	4	0	2
7	19	F		X	X					II	4	I	2
8	29	F	X	X	X			X	X	II	3	II	3
9	27	F	X	X	X			X	X	II	3	0	2
10	55	F	X	X	X	X	X			II	4	I	2

Table 2. Distribution and severity (0, 1, 5 points) of symptoms included in the clinical dysfunction index, D_i (0 = absence of clinical findings, I = slight, II = moderate, III = severe clinical signs of dysfunction.)
 p = total dysfunction score (points)

Patient	Mobility	TMJ- function	Muscle pain	TMJ- pain	Pain on movement	Occasion I		Occasion II	
						p	D_i	p	D_i
1	1	1	5	1	5	13	III	1	I
2	0	1	5	0	1	7	II	7	II
3	0	1	5	0	5	11	III	1	I
4	0	1	5	0	1	7	II	7	II
5	0	1	5	5	5	16	III	3	I
6	1	1	5	1	5	13	III	2	I
7	0	0	1	5	5	11	III	2	I
8	0	1	5	1	5	12	III	11	III
9	0	1	5	1	5	12	III	11	III
10	5	1	1	0	0	7	II	3	I

Table 3. Mean differences, in mm, between recordings (THR) made by different operators and by the same operator with light and heavy pressure on the same occasion

Recording	Antero-posteriorly		Medio-laterally	
	Occasion I	Occasion II	Occasion I	Occasion II
Light pressure, Op I – Light pressure, Op II	-0.09	0.04	-0.08	-0.12
Heavy pressure, Op I – Heavy pressure, Op II	0.09	0.04	-0.12	-0.10*
Light pressure, Op I – Heavy pressure, Op II	-0.09	-0.12	-0.12	-0.08
Heavy pressure, Op I – Light pressure, Op II	0.08	0.20	-0.06	-0.14*
Light pressure, Op I – Heavy pressure, Op I	-0.20*	-0.16*	0.03	0.02
Light pressure, Op II – Heavy pressure, Op II	-0.03	-0.16	-0.09	0.04

* = $0.01 < p < 0.05$

scribed (4, 5, 6). Acrylic splints were fastened on the upper and lower teeth. The upper splint was equipped with a precision metal-holder for exchangeable waxed glass-slides (Fig. 1), while the lower splint had a pointed tracing screw (width 0.3 mm).

To prevent movements of the mandible from interfering with contact between the maxillary and the mandibular appliances the bite was raised between 3.5 and 5.5 mm (mean 4.4 mm) as measured at the incisors. The adjusted vertical dimension was not changed during the examination period.

The antero-posterior and medio-lateral position of the point of contact of the tracing screw and the glass slide were measured to the nearest tenth of a millimeter. The measurements were independently made by two operators with the aid of calipers (7) and the mean values were used for calculations. Recordings 5–7 were measured according to Fig. 2 with the aid of a coordinate grid after 10-fold photographic magnification (4).

During the recording, the patient sat reclined in a dental chair; the back and neck supports were adjusted so that Camper's plane was horizontal.

On each occasion the following recordings of the retruded position were performed in random order:

1. Passive recording with light pressure, Operator I
2. Passive recording with strong pressure, Operator I
3. Passive recording with light pressure, Operator II
4. Passive recording with strong pressure, Operator II
5. 10 passive recordings on the same glass slide with light pressure, Operator I
6. 10 active recordings on the same glass slide, Operator I

In addition the following recording was made:

7. 10 habitual closures on the same glass slide, Operator I.

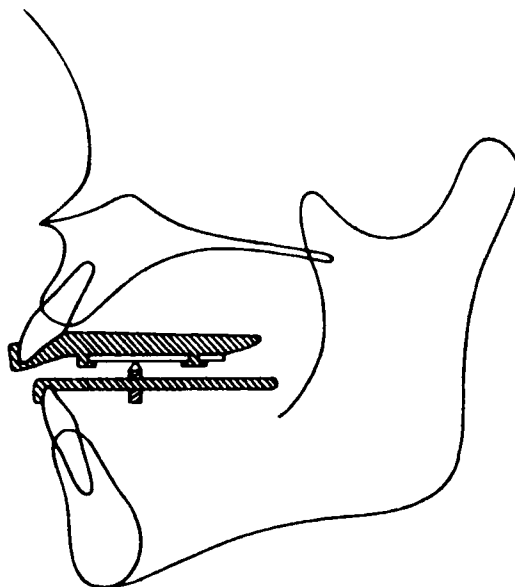


Fig. 1. Apparatus for intraoral graphic recording.

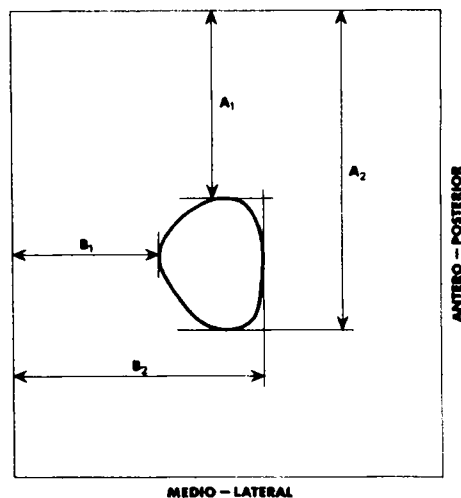


Fig. 2. Measurement of the size and the position of the clusters in recording 5–7.

Recordings 1–5 (terminal hinge recording, THR) were performed by guiding the mandible in a terminal hinge movement by pressing the relaxed mandible backwards with the right thumb, while gripping the chin with the index finger. Both examiners

had experience of recording with light and heavy pressure and estimated these to be 0.5 and 2.5 kg respectively (7).

The passive recordings were made without conscious cooperation from the patients, who were instructed to relax.

Recording number 6 was performed without operator guidance. The subjects were only instructed to close the mouth with simultaneous active retraction of the mandible (active terminal hinge recording). Recording number 7 was also made actively by the patient after instruction from the operator. The aim of the repeated closures (recording 5–7) was to study the dispersion of the marks of contact between the tracing screw and the glass slide.

Statistical methods

The occurrence of systematic differences between repeated recordings was examined by calculation of the mean difference and the mean error of the difference, $M_D \pm eMD$. With the t-test it was checked whether the mean difference differed significantly from 0. Accidental errors, (s_i) between two recordings were calculated from the formula,

$$(s_i) = \sqrt{\frac{\sum(x_1 - x_2)^2}{2n}}$$

RESULTS

Recordings on the same occasion

The precision of the recordings was judged as follows:

- 1) by calculation of systematic and accidental errors;
- 2) by comparison between two operators and
- 3) by comparison between light and heavy pressure of the same operator.

The *systematic* errors were small 0.2 mm at the most and only occasionally statistically significant (Table 3).

In *antero-posterior direction* a significant difference was found for Operator I, but not for Operator II, between recordings with light and heavy pressure on both occasions. Operator I recorded the retruded position on the average 0.2 mm more posteriorly with the heavy pressure than with the light.

In *medio-lateral direction* a small, but statistically significant difference was found between the two operators on Occasion II (but not on Occasion I). On recording with both light and heavy pressure Operator II recorded positions 0.1 mm more to the left than did Operator I with heavy pressure (Table 3).

The *accidental errors* were not larger when the recordings were made by different operators than by the same operator. The errors were of the same magnitude in antero-posterior and medio-lateral directions and of the same magnitude (0.1–0.2 mm) on both Occasion I and II. The two largest errors, 0.25 and 0.27 mm respectively, were mainly due to variations in one, single individual.

Recordings on different occasions

Both operators recorded the retruded position on the average 0.2 mm more posteriorly on Occasion II than on Occasion I. The difference was statistically significant for Operator I with light pressure and for Operator II with heavy pressure (Table 4). In medio-lateral direction there was no significant systematic difference found between the recordings on the two occasions. The accidental errors (Table 5) were of about the same magnitude as for recordings on the same occasion.

Results of recordings 5–7 (10 repeated closures)

In comparison between passive terminal hinge recordings, active terminal hinge re-

cordings and habitual closures, the passive terminal hinge recording showed the best consistency. The area represented by 10 repeated contacts on the glass slide (Fig. 2) was on the average considerably smaller for the passive method than for the two other methods (Table 6).

The size of the cluster obtained with the passive recording method did not change significantly after treatment neither in antero-posterior nor medio-lateral directions. For active hinge recordings and habitual closures the cluster size decreased on the average somewhat after treatment, but never significantly and never to the small size of the passive recordings.

On Occasion II the most distal border of the passively recorded cluster was located on the average 0.24 mm more posterior than on Occasion I. The corresponding measuring points of the actively recorded clusters and the habitual closure cluster moved still more posterior on Occasion II than on Occasion I (on the average 0.74 mm and 0.90 mm respectively). The difference in location of the measuring point between Occasion I and II reached statistically significant level only for habitual closures. No significant difference was found in the medio-lateral position of the cluster before and after treatment.

DISCUSSION

The investigation was performed by the same examiners and with the same methods as were previously used for recordings in persons with a healthy masticatory system (4, 5, 7). The previous studies were performed in male dental students. Other differences between this study and the previous ones were that the patients in this investigation were of both sexes, on the average somewhat older than the students and, above all, had pronounced symptoms of mandibular dysfunction. The material used

in this study therefore reflects more realistically the conditions of recording in clinical practice.

In this material there was a somewhat larger tendency to systematical differences between the recordings than that which was found among healthy subjects (4, 7). Neither the systematic nor the accidental errors were larger on Occasion I than on Occasion II when the patients were symptomfree or improved. The somewhat lower precision of the recordings among the patients in this study can therefore not entirely be attributed to the mandibular dysfunction symptoms. But, the systematic difference between Occasion I and II as to the position of the mandible is interesting. When the functional state of the masticatory system was improved the mandible could be positioned somewhat further distally than during the more acute stage of the symptoms. Possible explanations for this difference might be that a certain protective protruding mechanism could be elicited only in the acute stages of the disorder, or that the muscles were not relaxed enough on Occasion I. It is not possible to exclude the fact that some other factors might have changed between the two recording sessions e.g. varying shapes and periodically varying fluid content of the temporomandibular joints as suggested by Shafagh et al. (12).

Active recordings of the retruded position of the mandible seem to be influenced to a greater extent of dysfunction symptoms than passive recordings. This was evident from the fact that the most posterior border of the clusters moved more posterior after treatment of the symptoms in active than in passive recordings.

The size of the cluster obtained after repeated passive recordings was also very small as compared to the clusters obtained after the other two ways of recording. The mean diameter before as well as after treatment in both antero-posterior and medio-lateral direction was about 0.5 mm for the passive recordings. But, it should be kept in mind

Table 4. Mean differences, in mm, between recordings (THR) made with light and heavy pressure by the same operator on different occasions

Recording	Antero-posteriorly		Medi-laterally	
	Light pressure	Heavy pressure	Light pressure	Heavy pressure
Op I, Occasion I – Op I, Occasion II	-0.24**	-0.18	-0.03	0.04
Op II, Occasion I – Op II, Occasion II	-0.14	-0.23**	-0.11	0.01

** = 0.001 < p < 0.01

Table 5. Accidental errors (s_i), in mm, on comparison between recordings (THR) made with light and heavy pressure by the same operator on different occasions

Recording	Antero-posteriorly		Medio-laterally	
	Light pressure	Heavy pressure	Light pressure	Heavy pressure
Op I, Occasion I – Op I, Occasion II	0.21	0.23	0.21	0.24
Op II, Occasion I – Op II, Occasion II	0.19	0.22	0.23	0.14
Mean	0.20	0.23	0.22	0.16

Table 6. Mean, $\bar{x}$, and standard deviation, s.d. (in mm) of the largest antero-posterior (A_2-A_1 in Fig. 2) and medio-lateral diameters (B_2-B_1 in Fig. 2) of the cluster obtained by various recording methods

Recording method	Antero-posterior diameter				Medio-lateral diameter			
	Occasion I		Occasion II		Occasion I		Occasion II	
	$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.	$\bar{x}$	s.d.
Passive THR	0.55	0.26	0.52	0.16	0.50	0.17	0.43	0.07
Active THR	1.84	1.60	1.47	1.13	1.47	1.57	1.11	1.05
Habitual closures	1.88	1.06	1.59	1.44	1.39	0.97	0.76	0.38

that on the average 0.3 mm of this area represents the width of the tracing stylus. Had it been possible to make the stylus extremely thin, the actual size of the cluster might not have been larger than around 0.2 mm after the passive recordings, whereas the actively recorded clusters still would have been around 1.5 mm.

The difference between mandibular positions after passive recording in an acute stage of the symptoms and after some period of treatment was, on the average, not larger than the figures found for a comparison between recordings with light and heavy pres-

sure exerted by the same operator or between two different operators on the same occasion.

Even if both systematical and accidental errors tended to be somewhat larger than among normal, healthy individuals, there seems to be little reason to recommend *general* use of a bite splint before recording of the retruded position in patients with TMJ dysfunction symptoms. Furthermore, it does not seem to be indicated with various kinds of "neuro-muscular conditioning" e.g. with Myo-monitors, anterior jigs or cotton rolls as has been suggested (1, 10, 13).

Based upon the results of this study, simple instruction in relaxation of the jaw for a passive registration is sufficient to secure a recording of the retruded position of the mandible with clinically acceptable certainty in most situations.

The precision of passive recordings of the retruded position with distal pressure has in previous studies of normal patients been found to be considerably higher than for the muscular position (4) and also higher than for recordings with "moderate chin guidance" (5). This finding was also verified in this patient material. The use of the retruded position as a reference position can therefore be recommended also for individuals with mandibular dysfunction symptoms. During the recording the conventional technique with passive hinge movement and a posterior pressure should be used.

It is recommended that an occlusal adjustment be checked and readjusted after the symptoms have disappeared. Even if the positional changes before and after treatment of the symptoms were on the average small in this material, ($\bar{x} = 0.20$ mm) there might in single cases be relatively large differences between the retruded position recorded in an acute stage of the symptoms and after treatment.

No *extensive* occlusal adjustment or reconstructive work should therefore be initiated on a patient with acute TMJ-muscle-pain dysfunction symptoms until relief of the symptoms has been achieved e.g. by the aid of a bite splint. In this study, however, the maximum difference in antero-posterior direction before and after treatment was 0.7 mm and in medio-lateral direction 0.9 mm.

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