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MASTICATORY FUNCTION — A CINERADIOGRAPHIC INVESTIGATION

I. POSITION OF THE BOLUS IN FULL UPPER AND PARTIAL LOWER DENTURE CASES

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INTRODUCTION

Masticatory pressure, loading and masticatory efficiency have greatly interested research workers in prosthetics, but less so the position and displacement of the bolus during the act of chewing. It is true that it is possible to locate the bolus from studies of masticatory pressure and loading (*Kaires* 1959: *Trapozzano*, 1959), but only approximately, and the findings will apply only to the area where the recording apparatus has been applied, usually at a single tooth. An examination of mandibular movements in chewing can also provide a rough impression of the position of the bolus — as is evident from, for instance, *Hildebrand's* investigation (1931). However, most such studies of movement do not permit of accurate analyses of the position of the

bolus during chewing. Such an analysis has been conducted by the present authors. The study was performed on persons with full upper, and partial lower denture. Special registration and analysis techniques were designed.

MATERIAL

From the patients at the Royal School of Dentistry, Stockholm, who, 6—12 months earlier, had received full upper and partial lower double free-end dentures 25 were drawn at random and asked to attend for an examination. Twenty of them appeared in response to the request; 2 were absent on account of illness and the other 3 declared that they could not afford the time to participate in the study.

Table I. *Age and sex distribution of the patient series. Groups 1 and 2 are sub-groups with respect to presence of lower incisors.*

Age group	Men			Women			Total
	Group 1	Group 2	Both groups	Group 1	Group 2	Both groups	
40—49	2	1	3	2		2	5
50—59	2	1	3	2	2	4	7
60—	2	4	6	2		2	8
	6	6	12	6	2	8	20

The age and sex distribution of the material is given in table I. The material was divided into two groups, according to whether or not the lower incisors were present.

The treatment was carried out between 1962 and 1964 at the students' clinic in the Department of Prosthetics. One of the patients had previously not worn dentures, 12 had worn upper dentures, and the others both upper and lower ones. According to the record cards and their own statements the patients were in sound health.

The subjects in group 1 had a Kennedy class 1 residual dentition and their lower dentures had thus only free-end saddles. The residual dentition of the subjects in group 2 was classified

as Kennedy class 1, modification 1 and had not only double free-end saddles but also a bounded saddle for the missing lower incisors. The number of residual teeth was 5—8 in group 1 and 2—4 in group 2. All the lower dentures had been designed for both periodontal and gingival support, and clasp retention.

The condition of the dentures was estimated by two of the authors perfoming a clinical evaluation according to a specially designed standard scheme. Particular interest was attached to the occlusion, the stability and the retention of the dentures. The registration and classification were carried out as reported by *Koivumaa, Hedegård & Carlsson* (1960) and *Bergman, Carlsson & Hedegård* (1961).

Occlusal contact was registered in all cases. Poor stability was recorded for 2 upper dentures and 1 lower. The retention was clinically acceptable in all but 2 cases for both upper and lower dentures.

METHOD

The position of the test bolus during mastication was recorded by cineradiography. An electronic image intensifier was used (*Lundberg*, 1963).

Exposures were made with lateral and frontal (postero-anterior) projections. The central ray, which was oriented horizontally, was incident on the midpoint of the centre of the image intensifier, and perpendicular to its plane. The distance from the focus to the primary screen of the image intensifier was 125 cm. The whole image field, 13 cm in diameter, was used.

For the lateral projection the patient was placed so that the midplane of the face was 12.5 cm from the primary screen of the image intensifier the head resting on the head rest, with the Camper plane roughly horizontal. In the frontal projection the forehead rested on the image intensifier; the molar region was then about 10 cm from the primary screen. In neither projection was the head immobilized.

The exposure data for the lateral projection were 70 kV_p, 4 mA and about 20 frames a second, and for the frontal projection 90 kV_p, with the same current and speed.

The test foods used were bread and a toffee. Both contained

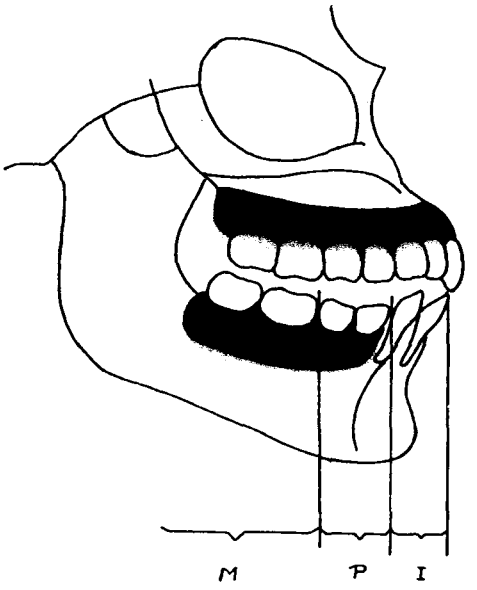

Fig. 1. The segments of the dental arch in lateral projection

about 30 per cent of barium contrast medium. The bread had the consistency of ordinary wheat bread at least one day old, and the toffee was extremely hard and tough. The test food was clearly visulized on the film. The procedure for the analysis of the films was the following. The film was shown in a horizontal projector (*Lundberg,* 1963), and 5 observers simultaneously but independently recorded the position of the bolus in relation to the lower dental arch. For the profile and frontal analyses the arch was divided into three segments. The profile analysis covered the anterior region to the canine *(segment I)* premolar region *(segment P)* and molar region, distally of the second premolar *(segment M)* (Fig. 1). The frontal analysis covered the region distally of — 3 *(segment R),* the region 3 — ... — 3 *(segment F)* and distally of 3 — *(segment L)* (Fig. 2).

The analysis was performed for consecutive masticatory cycles, a cycle being taken as the movement of the madible between two consecutive closures. The analysis did not include the biting cycle. The first chewing cycle was taken as that following the act of biting. In the analysis the film was first run continuously to

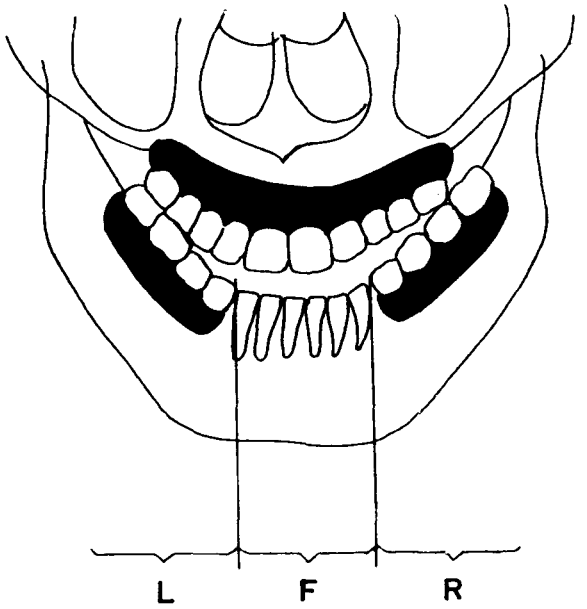

Fig. 2. The segments of the dental arch in frontal projection.

acquaint the observers with the position of the bolus in the mouth. The film was then run cycle by cycle, and after each one the film was stopped and the observers recorded the segment or segments in which they considered the bolus to lie during the closing movement. The first 20 cycles were analysed. In the few cases in which the chewing ended before 20 cycles had been performed the analysis was made of all the cycles up to the moment swallowing began. From the 5 individual records a majority report was then compiled — also cycle by cycle. These findings are reported below.

METHOD ANALYSIS

The apparatus, consisting of an X-ray tube, an image intensifier and a cine camera, was tested for geometric systematic and accidental errors (*Torlegård & Wictorin*, 1966). The systematic errors expressed as radial distortion proved to be quite small (0.04 mm), and in a qualitative study of the present type they were negligible.

It was possible to obtain information on the error of the method

Table II. *Deviations from the majority conception for ea*
patient for registration of 5 patients selected at r

	OBSERVER							
	A		B		C		D	
Case	Profile	Frontal	Profile	Frontal	Profile	Frontal	Profile	Fr
1	4	4	0	2	3	0	3	
2	2	4	0	1	0	0	0	
3	5	4	2	1	0	2	1	
4	2	6	4	1	2	2	5	
5	3	3	1	1	0	2	3	
Total	16	21	7	6	5	6	12	1
Mean per patient	3.2	4.2	1.4	1.2	1.0	1.2	2.4	

incurred in the film analysis by examining the discrepancies between the observers, that is, deviations from the majority findings. Such an examination was performed on 5 randomly selected patients (Table II) for both lateral and frontal projections. The discrepancies between observers A and C were obvious. The deviations appear not to have affected one subject appreciably more than the others, although one of them (no. 2) showed considerably less divergence than the average in the analysis of the lateral radiographs. There was no marked tendency for the deviations to be localized in any particular cycle or group of cycles, they being distributed fairly uniformly over the 20 cycles. There were deviations from the majority findings in about 10 per cent of the 1000 recordings (observers, 5 patients, 20 cycles each).

Another measure of the reliability of the method was the extent to which the majority finding were based on complete agreement between the observers. In the evaluation this was found in 73 per cent of the lateral films and in 64 per cent of the frontal. In 27 and 36 per cent, respectively, the findings of at least one observer were discrepant; discrepancies between observers were thus fairly common. An examination was therefore made of their characteristics. In all cases the deviations were of a borderline nature (for instance, I—IP, L—LF). In no case was there a discrepancy of two steps (I—M or L—R). In view of the relatively small regions and the fact that the exact border between them is diffuse, such deviations were to be expected. Deviations whereby a particular observer generally did not record the majority findings were rare (for instance, registration only of P, with the majority result I). The majority findings were thus a reliable indicator of the position of the test food in the mouth.

The method error for the registration and observation error can be found by comparing for each patient the number of I-cycles in lateral radiographs with the number of F-cycles in frontal films. This test carried out with bread for all the patients in the series showed a close correlation ($r = 0{,}76$) (Fig. 3). In this connection however, it must be borne in mind that since the lateral and frontal films were not exposed simultaneously the deviations were probably due also to intra-individual variations in the masticatory pattern.

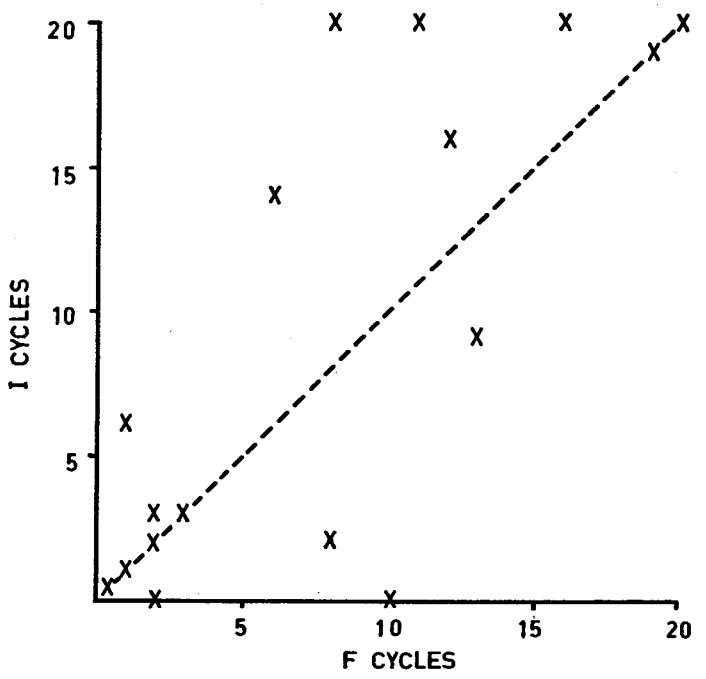

Fig. 3. Correlation between I and F cycles for bread mastication; whole material.

To summarize, the methods of registration and analysis were found to be suitable for a study of the present type. The reliability of the method would seem to be satisfactory.

STATISTICAL METHODS

The following formulae were used in the statistical analysis.

$$\textit{Correlation coefficient: } r = \frac{\sum (x_I - \bar{x}_I)\ (x_F - \bar{x}_F)}{\sqrt{\sum (x_I - \bar{x}_I)^2 \sum (x_F - \bar{x}_F)^2}}$$

where x_I and x_F are the values for segments I and P respectively.

Critical ratio for paired variates: $$t = \frac{\bar{d}}{\sqrt{\frac{\sum (d_i - \bar{d})^2}{n(n-1)}}}$$

where $$\bar{d} = \frac{\sum d_i}{n} \qquad \text{and } d_i = x_{1i} - x_{2i}$$

Critical ratio for unpaired variates: $$t = \frac{\bar{x}_I - \bar{x}_{II}}{\sqrt{(\text{S.E.}_{\bar{x}_I})^2 + (\text{S.E.}_{\bar{x}_{II}})^2}}$$

The *mean* ($\bar{x}$), *standard deviation* (S. D.) and the *standard error* (S. E.) were also calculated.

The term significant was used in accordance with the following convention. If an observed difference between two means was of such a magnitude that the probability *P* of obtaining a difference at least as great as the observed value was greater than 0.05, the observed difference was said to be not significant.

If $0.01 < P \leq 0.05$, the difference was said to be almost significant and was denoted +.

If $0.001 < P$ 0.01, the difference was said to be significant and was denoted + +.

If $0.001 > P$, the difference was said to be (highly) significant and was denoted + + +.

RESULTS

On the basis of the majority findings the means were calculated for the number of masticatory cycles for which the bolus was found in the respective segments (I, P and M in lateral projection and R, F and L in the frontal projection); the patient was taken as the unit.

It is evident from the table III that for lateral records the P-segment was the one most commonly involved in chewing both bread and toffee, next came the M- and I-segments, in this order. In 94.6 per cent of the cycles for bread and 85.8 per cent for

Table III. *Mean number of chewing cycles ($\bar{x}$), standard deviation (SD) and standard error (SE) for the whole material; chewing of bread and toffee; lateral projection.*

	Bread			Toffee		
	I	P	M	I	P	M
$\bar{x}$	9.0	17.6	14.0	9.6	16.9	13.4
SD	8.63	3.29	7.16	7.42	3.99	6.94
SE	2.10	0.52	1.74	1.86	1.00	1.75

Table IV. *Mean number of chewing cycles for the whole material; chewing of bread and toffee; frontal projection.*

Segment	Bread			Toffee		
	R	F	L	R	F	L
Mean number of cycles	14.4	7.5	14.4	8.1	5.7	13.4

Table V. *Differences in the mean ($\bar{d}$), standard error (SE) and t for comparison of frequency between the three segments; the whole material; lateral projection.*

	Segments	$\bar{d}$	SE	t
BREAD	P—I	8.6	2.39	3.6**
	P—I	5.0	3.29	1.5
	M—I	3.6	1.21	3.0**
TOFFEE	M—I	7.3	2.90	2.3*
	P—M	3.8	3.51	1.2
	P—M	3.5	1.08	3.3**

toffee the P-segment was used. The corresponding values for the M-segment were 75.6 and 68.0 per cent, and for the I-segment 48.6 and 48.7 per cent.

For the frontal registration the percentage differed slightly (Table IV). For bread the R- and L-segments were used to the same extent, 77 per cent, while the F-segment showed a much lower frequency, 40 per cent. In chewing toffee, on the other

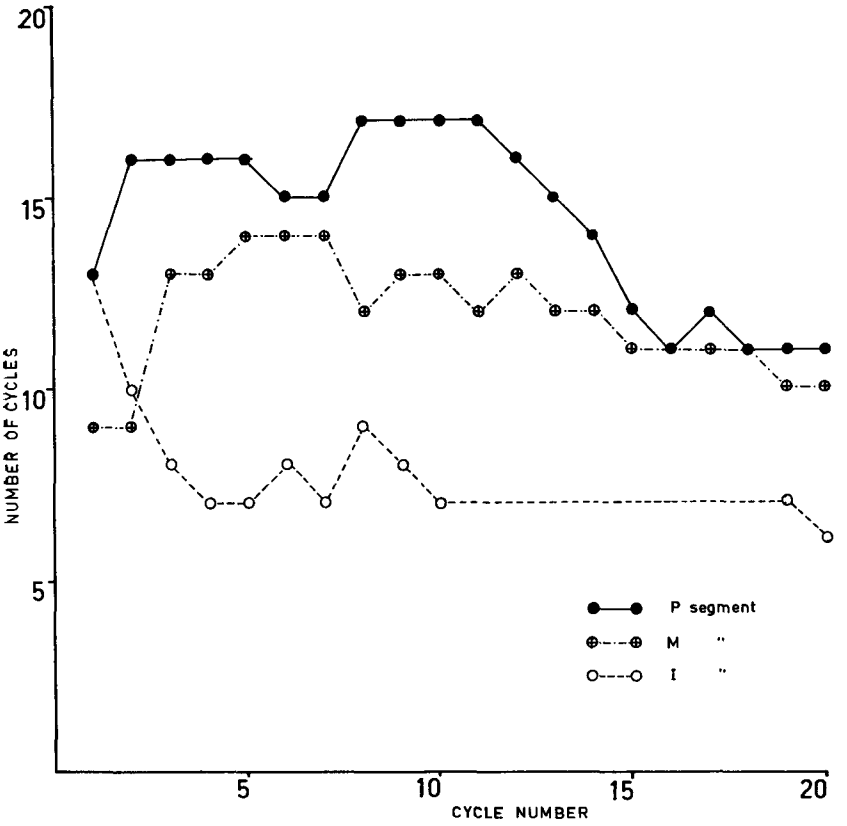

Fig. 4. Position of bolus in lateral projection; mastication of bread.

hand, there was a difference between the R- and L-segments, with frequencies of 40.5 and 67.0 per cent, respectively. The F-segment was used in 28.5 per cent of the cycles.

To ascertain whether there were any significant differences in masticatory frequency for the various segments in the lateral projection, an analysis of significance was performed by the *t* test, a critical value *t* being calculated for paired differences (Table V). In respect of bread, significant differences in chewing frequency were obtained between the I- and P-segments, and between the P- and M-segments. For toffee significant differences were found only between the P- and M-segments. The difference between the P- and I-segments was almost significant.

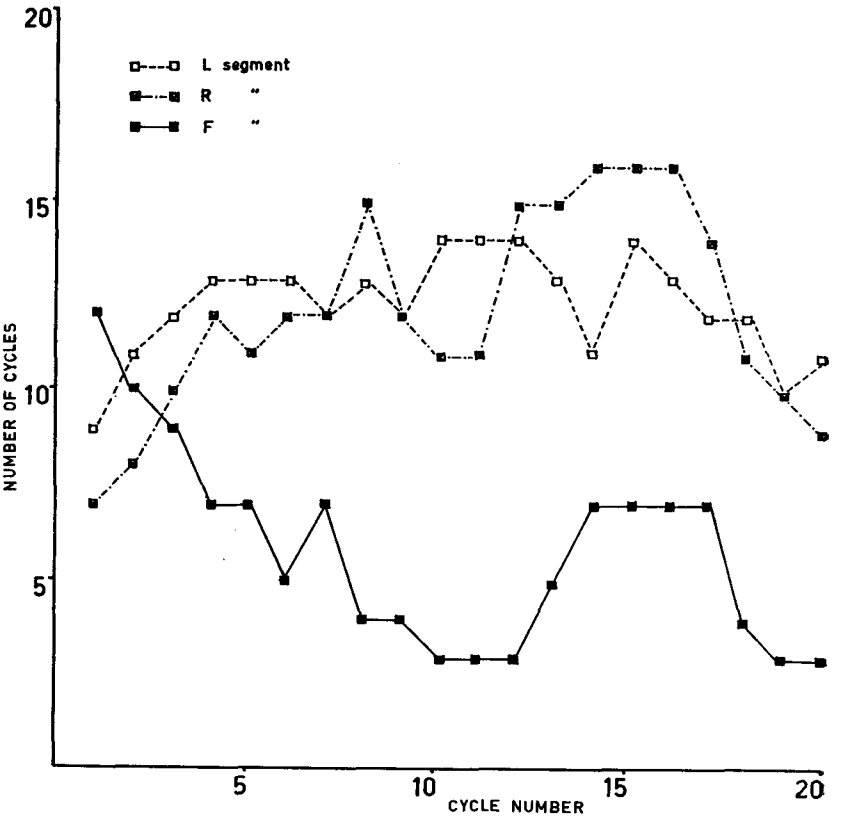

Fig. 5. Position of bolus in frontal projection; mastication of bread.

There were no significant differences between the I- and M-segments for either bread or toffee.

The above values are the total masticatory frequencies in the various segments. However, the segments were not used to the same extent over the test period. The part of the chewing cycles in which the respective segments were active and the variation in frequency are shown in Figs. 4—7. In the diagrams the x axis gives the cycle number and the y axis the number of engaged cycles for the respective segments: Each value of y is the total value of the number of masticatory cycles for the whole material.

For bread the anterior segment (I and F) was one most commonly used during the initial cycles, the frequency decreasing

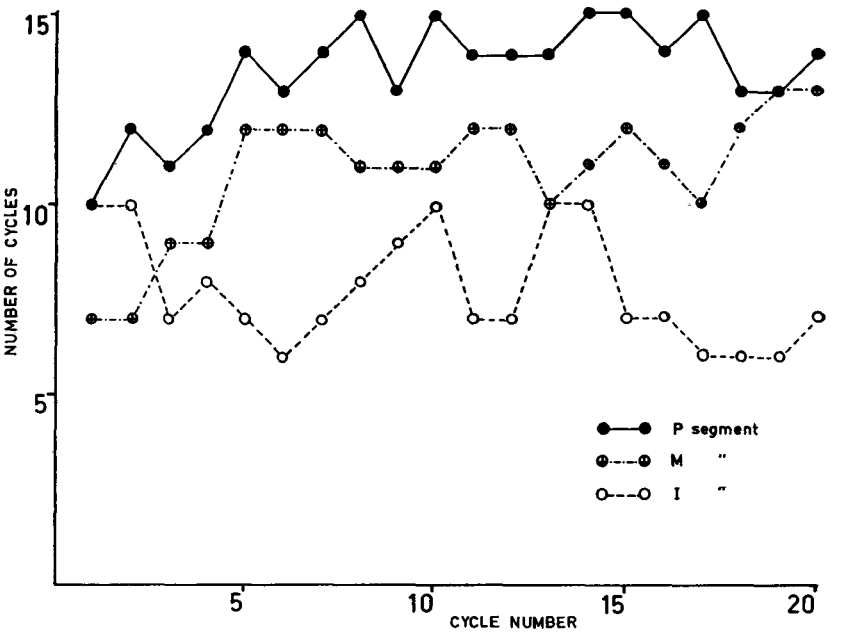

Fig. 6. Position of bolus in lateral projection; mastication of toffee.

rapidly to a fairly constant low value (Figs. 4 and 5). The frequency for the P- and M-segments increased rapidly during the first 5 cycles, stabilized during the next 10—15 cycles, and then diminished. After the first 2—4 cycles the frequency for the anterior segment was considerably lower than those for the premolar and molar segments.

The corresponding graphs for toffee (Figs. 6 and 7) display a slightly different and more uniform pattern. After the initial cycles the frequencies for the anterior segment diminished slightly, but not so much as for bread. The differences between the front, premolar and molar segments were small. The values were not regular but varied considerably for each cycle.

The graphs show the frequencies with which the individual segments participated during the course of the test period. The analysis of the films, however, showed that several segments were involved simultaneously. This tendency was most marked in the lateral projection. The values for the four most common combinations of segments, I, IP, IPM and PM are given in Figs. 8 and 9

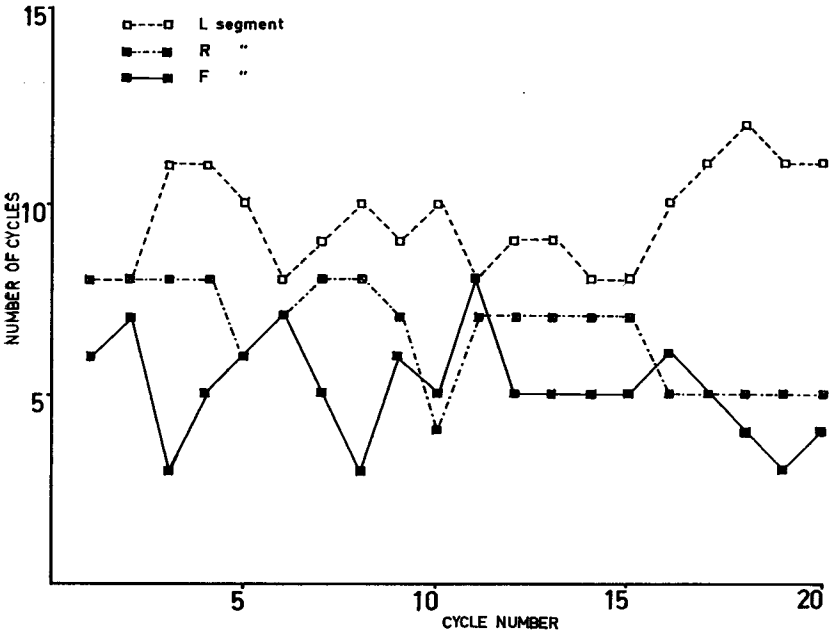

Fig. 7. Position of bolus in frontal projection; mastication of toffee.

(premolar and molar segments were used alone in only 2 and 1 cycles, respectively). For both bread and toffee the values for the combination PM were considerably higher than for the other segments; thus chewing occurred predominately in this segment. IPM was the next most common combination. The values for IP varied greatly but on the whole were lower than those for IPM, while the frequency for segment I was the lowest.

Here, too, there was a marked difference between bread and toffee. This was most pronounced for the I and the IPM regions. For toffee, chewing occurred in the I segment alone for all cycles, whereas for bread this pattern was absent in cycles 8—14 and 17—20. The frequency for the combination IPM in respect of bread was fairly constant, and from cycle 3 onwards the second most common, while for toffee the variation was slightly greater.

The effect of the test food on the pattern of mastication was examined also as the relation between the number of chewing cycles with the different test foods for a particular subject and segment. For no segment was any correlation found (the highest

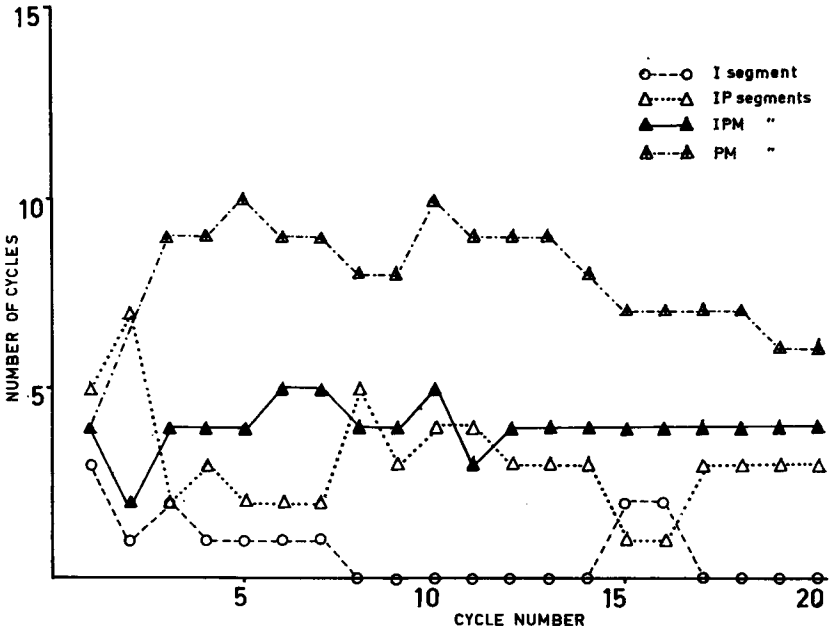

Fig. 8. Position of bolus in lateral projection; mastication of bread.

coefficient *r* was 0.51 for the segments P and F). Although the mean position of the bolus (Table III) for the respective foods was the same with one exception, it would seem that the position of the bolus in the various cycles during the continuous act of chewing is dependent on the consistency of the food.

Displacement of the bolus in frontal projection from one side to the other occurred in 75 per cent of the series in chewing bread and in 60 per cent for toffee. The corresponding figures for simultaneous bilateral placing of the bolus were 25 and 13 per cent. Unilateral chewing thus occurred only for toffee, and then in 27 per cent of the cases.

The mean for the change of sides was 1.8 for both bread and toffee. For intra-subject comparisons, however, there were considerable differences between the two test foods in this respect.

Within the series there were two distinct types of residual dentition and consequent differences in the required lower dentures. To examine the possible significance of the residual dentition for the positioning of the bolus the series was divided into two groups

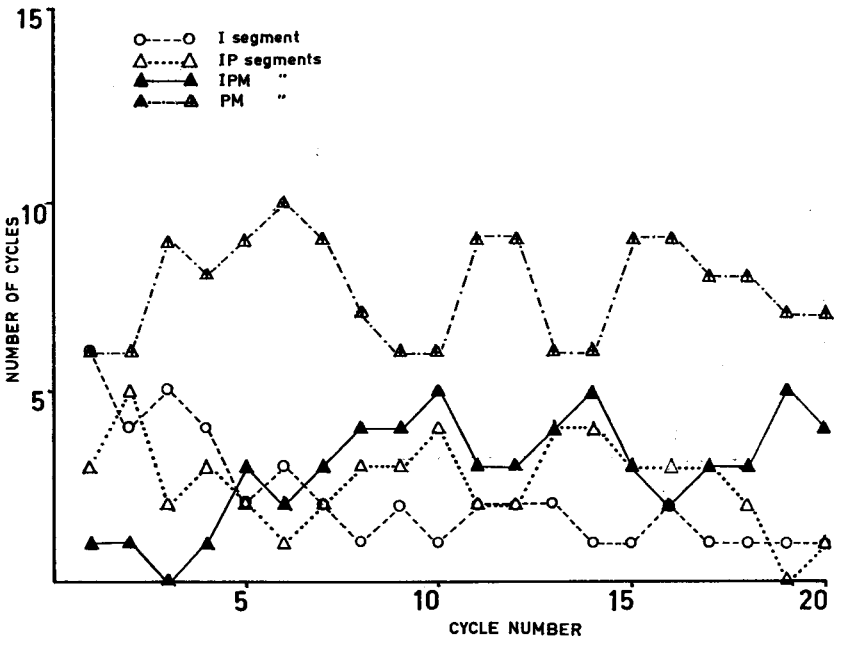

Fig. 9. Position of bolus in lateral projection; mastication of toffee.

according to whether the lower incisors were present or not — groups 1 and 2 , respectively. The mean frequencies for the various segments in the two groups were calculated, and the significance of the mean differences was analysed by the *t* test (Tables VI and VII).

Analysis by the t-test disclosed a highly significant difference between the molar and anterior segments for bread in group 2 but not in group 1. There were also significant differences between the means for the anterior segments in groups 1 and 2 for bread alone and for bread and toffee combined. Almost significant differences were found between the values for the molar and anterior segments in group 2 for toffee. This means that patients without their natural lower central and lateral incisors more often placed the bolus in the posterior segments. Group 1 (with their natural anteriors) used the anterior segment considerably more than group 2 when chewing bread. This applied also for bread and toffee combined, but not for toffee alone.

Table VI. *Mean number of chewing cycles for the whole material divided into groups 1 and 2; mastication of bread and toffee; lateral projection.*

Mean No of cycles	Bread			Toffee		
	I	P	M	I	P	M
Group 1	12.4	17.7	13.1	3.0	17.3	15.7
Group 2	10.7	16.4	12.0	7.2	12.0	16.6

Table VII. *Difference of the mean and t values for groups 1 and 2 for comparison of frequency in lateral projection. (Subscripts of segments denote the respective patient group.)*

	SEGMENT						Both
	Bread			Toffee			
	I_1—I_2	M_1—M_2	M_2—I_2	I_1—I_2	I_1—M_1	M_2—I_2	I_1—I_2
$\bar{X}_1$—$\bar{X}_2$	9.4	0.7	12.7 **	3.5	1.3	9.4	6.6
t	3.07	—	4.16**	—	—	2.45*	2.83**

DISCUSSION

Previous studies on the mechanism of the masticatory apparatus have been concerned with the pattern of movement of the mandible, movements of the temporomandibular joints, masticatory pressure and masticatory effect. Various recording methods have been used, depending on the problems approached. X-ray kymography was used by *Hildebrand* (1931), among others. With more recent developments in the field of radiology a cineradiographic apparatus has been designed which is suitable for investigation of the masticatory mechanism. The recording speed has proved to be satisfactory for the movements examined in the present study, and the accuracy and precision are also acceptable (*Torlegård & Wictorin*, 1966).

The position of the bolus in the first 20 masticatory cycles was examined in denture wearers. By adding contrast medium to the test foods the food could be clearly visualized. An analysis of the lateral and frontal projections of the jaw region was performed. The same chewing cycles could not be examined in the two projections simultaneously. Synchronous recording of the two projections is at present impossible, although it might appear to be simple in theory.

Analyses were made of the position of the bolus in various regions of the dental arches.

The deviations in observation were moderate, at about 10 per cent (Table II). For the present purpose the registration and analytical methods were sufficiently reliable. The reliability of the recording procedure could probably have been improved by marking the borders of the regions in the dentures with indicators. This would have been particularly useful for demarcating the premolar and molar regions.

Whether the recorded position of the bolus was wholly representative for the individual cannot be decided with certainty; it is possible that it is affected by the type of food and the experimental conditions. It would seem, however, that there was a close correlation in the registrations in the anterior segment between the frontal and the lateral projection (segments F and I), and this would bear out the impression gained from earlier studies that a particular subject chews in largely the same way from one occasion to another; that is to say, there is an individual pattern of mastication. From the individual registrations on changing from one side to the other with the two test foods it would seem that the masticatory pattern may be dependent on the consistency of the food. This possibility is worth pursuing further.

It is evident from the results that patients with full upper dentures and partial lower double free-end dentures used the molar and premolar segments to a greater extent than the incisor region, the ratio of the respective numbers of chewing cycles being 85: 68: 50. Although the residual teeth were situated in the incisor region, the chewing was more commonly performed in the posterior regions. The partial denture thus serves an important purpose also from the aspect of masticatory function. It was found that the anterior segment was used most during the first few cycles, while the premolar and molar regions were used most often during cycles 8—15. This would be expected in a series of subjects with a full complement of teeth but it is perhaps surprising in mouths where the molars and most of the premolars had been lost and replaced by free-end dentures. The fact that chewing was localized mainly to the posterior segments may be ascribed to the comparatively good state of the arches restorted by partial dentures. It should be pointed out, however, that from

this aspect there is a lack of knowledge of the masticatory habits for the normal dentition and of the individual variation.

The subjects thus made great use of the occlusal surfaces of the denture teeth for chewing both soft, fairly easily masticated food and tough food. There has hitherto been a prevalent view that the food during chewing is placed predominantly in the segments with residual teeth. The results of the present study show that from the aspect of masticatory function the partial denture should invariably be considered in the case of ravaged dentitions. The impression that such patients tend to avoid using the partial denture when chewing food thus finds no support in the present results; it is conceivable that it may be based on experience of patients fitted with extreme denture constructions or that conclusions have been drawn on the basis of the few patients that cannot, or are unwilling to, adapt themselves to the new situation presented by the use of partial dentures.

The patients that had lost the incisors tended to use the anterior region less frequently. Although in all these cases the restoration was periodontically supported in the anterior segment such a restoration would seem to be less efficient than an arch with the natural incisors left. It is probably impossible with the present method to ascertain what factors are responsible for the patient avoiding a bounded saddle when chewing. This aspect of the problem probably calls for special methods, including loading experiments to examine the function of the bounded saddle.

The described method is suitable for use in future investigations of denture function. For instance, by studying various types of denture-constructions it should be possible to ascertain their suitability by examining the possible correlation between the functional pattern in chewing and clinical findings. To start with, however, knowledge is required of the position of the bolus when there is a full complement of natural teeth, and in the edentulous mouth with full dentures. Studies of this nature are at present being conducted.

SUMMARY

This paper reports results from a cine-radiographic investigation of bolus position during chewing in denture wearers. The

study was performed on 20 persons with full upper and partial lower dentures. The denture treatment was given 6—12 months before the study started.

The position of the test bolus — soft bread and tough toffee, both containing about 30 per cent of barium contrast medium — during mastication was recorded by cineradiography. An electronic image intensifier was used.

Exposures were made with lateral and frontal projections.

The procedure of the analysis of the films was the following. The film was shown in an horizontal projector and 5 observers simultaneously but independently recorded the position of the bolus in relation to the lower dental arch. For profile and frontal analyses the arch was divided into three segments. The profile analysis covered the anterior region to the canine, premolar region and molar region; the frontal analysis covered the region distally of —3, the region 3— — —3 and distally of 3— (Figs. 1 and 2).

The analysis was performed for consecutive masticatory cycles and the first 20 cycles were recorded. From the 5 individual records a majority report was compiled — also cycle by cycle.

It was evident from the results that patients with full upper and partial lower double free-end dentures used the molar and premolar segments to a greater extent than the incisor region, although the residual natural teeth were lower incisors. The partial denture thus serves an important purpose also from the aspect of masticatory function. It was found that the anterior segment was used most during the first few cycles, while the premolar and molar region were used more often during cycles 8—15.

The patients that had lost the incisors tended to use the anterior region less frequently, although the partial denture in all these cases were periodontically supported in the front region.

The method used proved suitable for future investigations of denturen function during chewing. Studies of this nature are at present being conducted.

RÉSUMÉ

LA FONCTION MASTICATRICE — ÉTUDE CINÉRADIOGRAPHIQUE

Le présent article rend compte d'une étude cinéradiographique de la position du bol alimentaire pendant la mastication chez les

porteurs de prothèses. Cette étude a été faite sur 20 personnes portant une prothèse complète du haut et une prothèse partielle du bas. Le traitement prothétique avait eu lieu 6—12 mois avant le début de cette étude.

Les aliments utilisés pour l'essai, du pain tendre et des caramels fermes, contenaient environ 30 % d'un produit opaque aux rayons X à base de baryum. La position du bol alimentaire pendant la mastication a été enregistrée par cinéradiographie. Un renforçateur d'image électronique a été utilisé.

Les prises de vue ont été faites en projections latérales et frontales.

L'analyse des films a été faite selon le procédé suivant: Le film était présenté avec un projecteur horizontal, et 5 observateurs notaient, simultanément, mais indépendamment les uns des autres, la position du bol alimentaire par rapport à l'arcade dentaire inférieure. Pour les analyses de profil et les analyses frontales, l'arcade était divisée en trois segments. L'analyse de profil englobait la région antérieure jusqu'à la canine, la région prémolaire et la région molaire; l'analyse de face englobait la région placée à la partie distale de —3 (3), la région 3———3 (3—3), et la région placée à la partie distale de 3— (3) (fig. 1 et 2).

L'analyse a été effectuée pour des cycles masticatoires consécutifs, et les observateurs ont enregistré les 20 premiers cycles. A partir des enregistrements faits par les cinq observateurs, on a établi un rapport conforme à la majorité, aussi cycle par cycle.

Il ressortait clairement des résultats obtenus que les porteurs d'une prothèse complète du haut et d'une prothèse partielle du bas à double extension distale utilisaient les segments molaires et prémolaires dans une plus large mesure que la région incisive, bien que les dents naturelles restantes fussent justement les incisives inférieures. La prothèse partielle joue donc un rôle important aussi du point de vue de la fonction masticatrice. Il s'est révélé que le segment antérieur était utilisé plus particulièrement pendant les 5 premiers cycles, tandis que les régions molaires et prémolaires étaient utilisées plus souvent pendant les cycles 8—15.

Les patients dont les incisives manquaient tendaient à utiliser

la région antérieure moins fréquemment, bien que la région antérieure des prothèses partielles fût dans tous ces cas soutenue par appuis parodontaires.

La méthode utilisée s'est révélée apte à servir pour les recherches à venir sur le fonctionnement des prothèses pendant la mastication. Des études de ce genre sont en cours actuellement.

ZUSAMMENFASSUNG

KAUFUNKTION. EINE CINERADIOGRAPHISCHE UNTERSUCHUNG

Dieser Artikel gibt die Resultate einer röntgen-kinematographischen Untersuchung wieder, die die Lage eines Bissens bei kauenden Prothesenträgern beschreibt. Die Untersuchung wurde an 20 Personen mit totalen Oberkiefer- und partiellen Unterkieferprothesen durchgeführt. Die prothetische Behandlung war 6—12 Monate vor der Untersuchung ausgeführt worden.

Der untersuchte Bissen bestand aus weichem Brot und zähen Sahnebonbons, die jeweils ungefähr 30 % Bariumkontraststoff enthielten. Die Lage des Bissens wurde während des Kauens durch Röntgen-Kinematographie abgebildet. Dabei wurde ein elektronischer Bildverstärker benutzt. Die Aufnahmen geschahen in Lateral- und Frontalprojektion.

Die Filme wurden auf folgende Art analysiert. Sie wurden in einem waagerechten Projektor vorgeführt. 5 Beobachter verzeichneten gleichzeitig, jedoch unabhängig von einander, die Lage des Bissens im Verhältnis zu dem unteren Zahnbogen. Für Profil- und Frontalanalysen wurde der Bogen in 3 Segmente eingeteilt. Die Profilanalyse deckte das Frontgebiet bis zum Eckzahn, das Praemolar- und das Molargebiet; die Frontalanalyse deckte das Gebiet distal von —3, das Gebiet von 3— bis —3 und das Gebiet distal von 3—. (Fig. 1 und 2.)

Die Analyse wurde bei aufeinander folgenden Kauzyklen ausgeführt und die ersten 20 Zyklen wurden registriert. Von den 5 individuellen Registrierungen wurde ein "majority report" zusammengestellt, — auch Zyklus um Zyklus.

Die Resultate zeigten klar, dass Patienten mit totalen Oberkieferprothesen und partiellen Doppelfreiend-Unterkieferprothesen die Molar- und Praemolarsegmente in grösserem Ausmass als das Schneidezahngebiet benutzten, obwohl das Restgebiss aus

unteren Schneidezähnen bestand. Die Partialprothese erfüllt also auch vom Gesichtspunkt der Kaufunktion aus eine wichtige Aufgabe. Es wurde festgestellt, dass das vordere Segment hauptsächlich während der ersten 5 Zyklen benutzt wurde, während das Praemolar- und Molargebiet öfter während des 8. bis 15. Zyklus benutzt wurde.

Die Patienten, die ihre Schneidezähne verloren hatten, neigten dazu, das vordere Gebiet seltener zu benutzen, obwohl die Partialprothesen in allen Fällen in dem Frontgebiet periodontal verankert waren.

Die angewendete Methode erwies sich für zukünftige Untersuchungen über die Prothesenfunktion während des Kauens geeignet.

Studien dieser Art werden im Augenblick weitergeführt.

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