The effect of increasing the morphologic face height in full denture restorations on the width of the intra-articular space in the temporomandibular joint

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In the present study an examination was made of the effect that an increase in the vertical dimension in accordance with the usual principles of full denture work can have on the width of the intra-articular space in the temporomandibular joint. The series consisted of 27 subjects that had previously worn dentures for at least 5 years and that subsequently received full upper and lower dentures. The denture treatment was carried out in accordance with accepted principles. In connection with the insertion of the new dentures a radiographic examination based on profile films and a serial tomogram was made with the old and then the new dentures in habitual occlusion. The morphologic face height and the width of the intra-articular space were measured on the films.

The results show consistently that the width of the joint space was not affected by considerable changes in the morphologic height of the face produced by the new dentures. High correlation coefficients were obtained for the relationship between the width of the intra-articular space with, the old and the new dentures. Thus, in case of a small joint space and the mandibular head in an unfavourable position in the articular fossa with the old dentures in the mouth, there was in most cases no improvement in the situation when the new dentures were inserted.

Key-words: Complete dentures; temporomandibular joint

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While the effect of full dentures on the supporting soft- and hard-tissues has been extensively studied from various aspects, their influence on the temporomandibular joint has received little attention. Using the conventional radiographic technique in a group of patients receiving immediate full upper dentures, *Hedegård & Lundberg* (1965) were unable to find any definite changes due to remodelling of the mandibular fossa or the articular tubercle over a 10-year period. The connection between the vertical dimension of the dentures and functional disorders of the masticatory apparatus have been dealt with by, for instance, *Harris* (1967), *Kulikowski, Daniel & Malejewska* (1969), *Zarb & Thompson* (1970) and *Weinberg* (1970); these authors point to the importance of ensuring a normal relation between mandibular

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condyle and fossa in the preparation of full dentures. In full denture patients *Gibson* (1967) found a relationship between reduced vertical dimension and temporomandibular pain.

Displacement of the condyle in the sagittal plane has been considered by *Schwartz* (1959) and *Posselt* (1962) to result in disorders of the masticatory muscles and temporomandibular joints. *Carraro, et al.*, (1967) and *Agerberg et al.*, (1970) also noted a high frequency of displacement of the condyles in patients with joint symptoms.

Recent investigations have shown that functional disturbances of the temporomandibular joints are relatively common in full-denture wearers (*Hansson & Öberg*, 1971; *Bergman & Carlsson* 1972). The effect of loss of teeth on the temporomandibular structure has been confirmed morphologically. In an autopsy series *Öberg, Carlsson & Fajers* (1971) found a significantly higher frequency of arthrosis in persons that were edentulous or that had a reduced dentition than in those with complete arches; in confirmation of *Blackwood's* (1969) findings, perforation of the articular disc and remodelling of the articular surfaces in the region of the perforation were recorded in a large proportion of persons. Since a reduced vertical dimension can result in a smaller joint space and this is the first sign of arthrotic change (*Hollander* 1966), it is important in the preparation of new full dentures to ensure a normal relation between mandibular head and fossa.

Tomography is a radiographic technique that has become an important aid in diagnosing disorders of the temporomandibular region. It has proved superior to conventional transcranial projections for ascertaining the size of the joint space and the position of the mandibular head in the fossa mandibularis. Because of the limited knowledge of mandibular head — fossa relation, and because an incorrect position of the condyle in the fossa mandibularis can lead to arthrosis and functional disorders, we undertook a tomographic examination of the effect that an increase in the vertical dimension — produced in accordance with the usual principles in full denture work — may have on the width of the joint space in the temporomandibular joint.

MATERIAL AND METHODS

The case series for the study consisted of all 27 persons that had previously worn dentures for at least 5 years and that during May 1971 had received full dentures in both jaws at the Department of Prosthetics at the University of Umeå. For technical reasons one patient was omitted and the study thus covered 26 persons of both sexes. Table I shows the total number of denture wearers and the distribution with respect to sex, age and the number of years the most recent full denture had been worn.

The denture treatment was performed by students under the supervision of teachers and in accordance with the principles followed at the Department of Prosthetics (*Bergman, Carlsson & Ericson*,

Table I. *The case series*

Sex	Number of patients	Mean age of patient in years	Age in years of most recent dentures (means)	Number of years as denture wearer (means)
Women	18	61.1	14.4	27.6
Men	8	59.3	10.8	23.5
Total	26	60.5	13.5	26.3

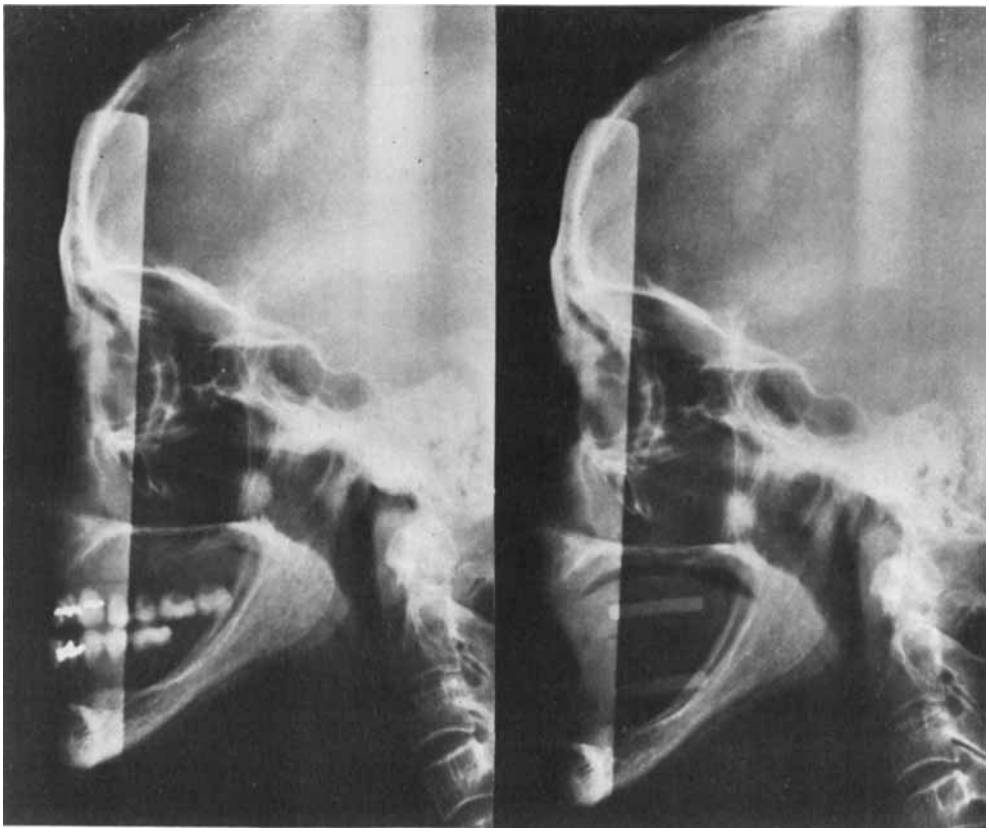

Fig. 1. Profile radiographs with the old (*left*) and new dentures (*right*) in occlusion. The new dentures increased the vertical dimension by 6 mm.

1971). The jaw registration was performed by means of bite rims. The morphologic vertical height of the face was determined with due regard to aesthetic factors, comfort and the size of the free-way space in the postural position. The free-way space was usually as close to 2—4 mm as possible. The retruded occlusal position was recorded and an attempt was made to obtain stability between this position and the habitual occlusion. Before delivering the new dentures, balanced occlusion and articulation was ensured by grinding in the articulator.

When the new dentures were inserted a radiographic examination was carried out with the old dentures, and then with the new dentures, in habitual occlusion. Two x-ray techniques were used, and the examinations were performed on the same occasion:

1. Two profile radiographs were taken in the cephalostat by the method described elsewhere (*Bergman et al.*, 1971), one with the old dentures and the other with the new in the mouth (Fig. 1).

2. Three pairs of tomograms of each joint were exposed, first with the old and then with the new dentures in habitual occlusion. The sections for each pair of tomograms were centred symmetrically on the mandibular head and oriented parallel with the sagittal plane in the middle of the joint with an interspace of 4 mm.

During the exposures and while the dentures were being changed the skull was fixed to the head holder so that corresponding sections of the joints could be obtained with the two sets of dentures. The examinations were performed with a Polytome Tomograph, and the Polytome hypocycloid movement pattern was used throughout. The exposure data were adapted to the patient's constitution.

The following variables were recorded on the radiographs:

1. Morphologic face height, defined as the nasion — gnathion distance N-Gn; measured on the profile radiographs with the dentures in habitual occlusion (Fig. 1). The measurements were performed directly on the radiographs with sliding calipers to the nearest tenth of a millimetre (see *Carlsson & Ericson*, 1967).

2. The increase in vertical dimension in the anterior segment of the face, represented by the difference in the nasion — gnathion distance with the new instead of the old dentures.

3. The width of the joint space with the old and new dentures; measured at points *P*, *C* and *A* on the tomograms (Fig. 2).

P. The shortest distance from the mandibular head to the posterior part of the mandibular fossa.

C. The shortest distance from the mandibular head to the most superior point in the mandibular fossa, measured perpendicular to a baseline drawn as the tangent from the inferior border of the external auditory meatus to the eminence of the articular tubercle.

A. The shortest distance from the mandibular head to the articular tubercle.

The measurements were performed on the tomograms — the most central section

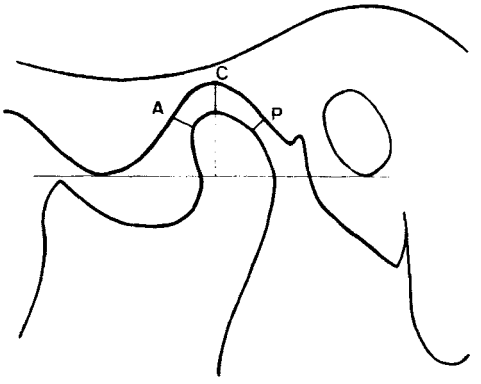

Fig. 2. Tracing of tomogram through the temporomandibular joint and external auditory meatus on the right side. The measured distances P, C and A are marked, as is the tangent from the inferior border of the external auditory meatus to the eminence of the articular tubercle and the perpendicular to the tangent through the mandibular head to the most superior point of the bottom of the fossa.

— with a magnifying glass in tenths of a millimetre after the anatomic details had been marked with a sharp pencil.

The sources of error in the radiographic methods have previously been analysed in part — as regards the profile radiographic method by taking replicate films in the same subject (*Carlsson & Ericson*, 1967). The mean error for the nasion—gnathion distance with the dentures in habitual occlusion was 0.24 mm for determinations performed on two films. In a study of the reproducibility of the tomographic method carried out as a model experiment on the cranium *Eckerdal* (1971) found that the hypocycloid tomographic motion used in the present study gave only little distortion of the object in the centre of the condyle compared with the anatomic original specimen; the magnitude of the distortion was negligible for the purpose of clinical research.

The measurement error was analysed in the present study. The method error for a single determination was calculated from

Table II. *Mean differences ($\bar{d}$) between pairs of measurements made by the same observer of the lengths N-Gn, P, C and A, the standard deviations ($S.D._k$) and the standard errors of the means ($S.E.M._k$)*

Number of observations	N—Gn			P			C			A		
	$\bar{d}$	$S.E.M._k$	$S.D._k$	$\bar{d}$	$S.E.M._k$	$S.D._k$	$\bar{d}$	$S.E.M._k$	$S.D._k$	$\bar{d}$	$S.E.M._k$	$S.D._k$
11	—0.03	0.04	0.14	—0.03	0.05	0.16	—0.24	0.10	0.32	—0.10	0.08	0.25

the formula $s = [(\Sigma d^2)/2n]^{\frac{1}{2}}$, where d is the difference between two measurements performed by the same investigator at an interval of one month, and n is the number of replicate measurements. The results are presented in Table II.

The numerical treatment of data was performed by computer, a standard programme being used for the statistical analyses.

RESULTS

The results are presented in Tables III—XI. Examples of the width of the joint space are given in Figs. 3—9. No differences that could be ascribed to sex were observed. As is seen from Table III the width of the intra-articular space posteriorly (P), centrally (C) and anteriorly (A) varied considerably. For all 3 distances, the variation, expressed as the standard deviation, was approximately the same with the new dentures as with the old. The range of variation, however, was consistently greatest for the new dentures — except for distance A on the right side.

The increase in the vertical dimension in the anterior segment as a result of the new dentures was on average 4.3 mm, with a range of 0.1 to 21.6 mm (Table III). For the patients wearing their latest dentures longer than the average time for the whole series (That is, more than 13.5 years) the mean increase in the vertical dimension was 4.0 mm with a range of 0.3—9.8 mm. The corresponding values for the patients wearing their latest dentures a shorter time than the average were 5.4 mm, and 0.2—21.6 mm. The difference in the increase in vertical dimension for the groups is not statistically significant.

The raising of the morphologic face height resulted in sagittal and vertical moving of the mandibular head in the fossa, but on average this was small; for the left and right sides the respective values for *P* were 0.6 and 0.4 mm, for *C* 0.8 and 0.2 mm and for *A* —0.1 and 0 mm

The moving of the mandibular head and the resulting change in the width of the intra-articular space of the TMJ displayed no uniform tendency. The ranges for the change on the left side were: for P —0.6 to 6.7 mm, for C —0.9 to 5.3 mm, and for A —1.2 to 0.4 mm; for the right side similar ranges were obtained (Table III). The position of the condyle in the fossa with the old and new dentures in occlusion is shown in Figs. 3—8.

An examination was made of whether there was any association between, on the one hand, changes in the morphologic face height when the new dentures were inserted and, on the other, the face height with the old dentures, the period the dentures had been worn, and the subjects' age and sex. Only in respect of the period the dentures

Table III. *Means ($\bar{x}$), Standard deviations ($S.D._k$) and ranges of the increase in vertical dimension as well as the width of the intra-articular space at three points P, C and A with the old and the new dentures in place. All dimensions in mm*

Increase in vertical dimension				Denture	Left intra-articular space								
					P			C			A		
$\bar{x}$	$S.D._k$	range			$\bar{x}$	$S.D._k$	range	$\bar{x}$	$S.D._k$	range	$\bar{x}$	$S.D._k$	range
				old	1.7	0.9	0.3—4.2	2.4	1.2	0.3—5.9	2.5	1.0	0—4.6
4.3	4.7	0.1—21.6		new	2.3	1.7	0.4—8.9	3.2	1.8	0.1—8.3	2.4	1.0	0—5.0

Increase in vertical dimension				Denture	Right intra-articular space								
					P			C			A		
$\bar{x}$	$S.D._k$	range			$\bar{x}$	$S.D._k$	range	$\bar{x}$	$S.D._k$	range	$\bar{x}$	$S.D._k$	range
				old	1.9	1.5	0 — 6.5	2.4	1.3	0.6— 6.0	2.5	1.0	0.8—5.5
4.3	4.7	0.1—21.6		new	2.3	1.3	0.4—11.1	2.6	1.2	0.8—10.4	2.5	0.9	1.1—4.8

had been worn was there a significant association, with r = —0.43* (Table IV); the negative sign indicates that the increase in vertical dimension was, on average, smaller for patients wearing dentures for a longer than a shorter time. The period the dentures were worn was consistently long (Table I).

Table V shows the width of the temporomandibular joint space with the new dentures in occlusion after an increase in vertical dimension smaller and larger than the mean for the whole population. There were no significant differences between the increase in vertical dimension and the width of the joint space except for the distance A in the right temporomandibular joint; this distance was on average significantly smaller in the group with an increase larger than the mean. The range for the width of the intra-articular space for all 3 distances on the tomograms in the two samples was, however large, but greatest in the group with the largest increase in vertical dimension — with the exception of the distance involving point A. Whether the head of the mandible initially had a more forward position in this group and, if so, whether it is just this situation that accounts for the significant difference in the right temporomandibular joint at A cannot be decided from the data in Table V.

To eliminate the effect of any original differences in the position of the mandibular head in the fossa with the old dentures

Table IV. *Correlation coefficients for the comparisons between the increase in vertical dimension with the new dentures and the age, sex, years of denture wearing and length N—Gn with the old dentures in occlusion*

Age	Sex	Number of years as denture wearer	N—Gn
—0.17	—0.26	—0.43*	0.29

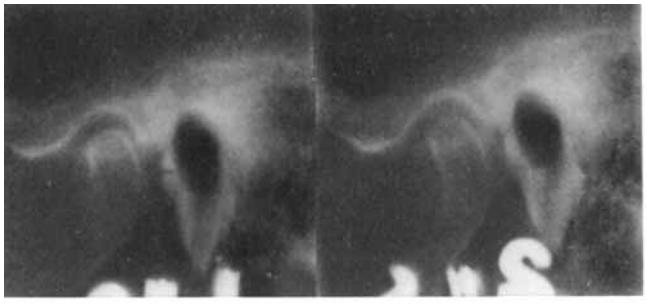

Fig. 3. Tomogram of right temporomandibular joint with old (*left*) and new dentures (*right*) in occlusion. The vertical dimension was raised by 2.5 mm. The condyle assumes a normal and unchanged position in the mandibular fossa.

Fig. 4 Tomogram of right temporomandibular joint with the old (*left*) and new dentures (*right*) in occlusion. The vertical dimension was increased by 0.1 mm. The condyle is displaced distally in the mandibular fossa and the intra-articular space is reduced in the posterior and superior parts in both situations.

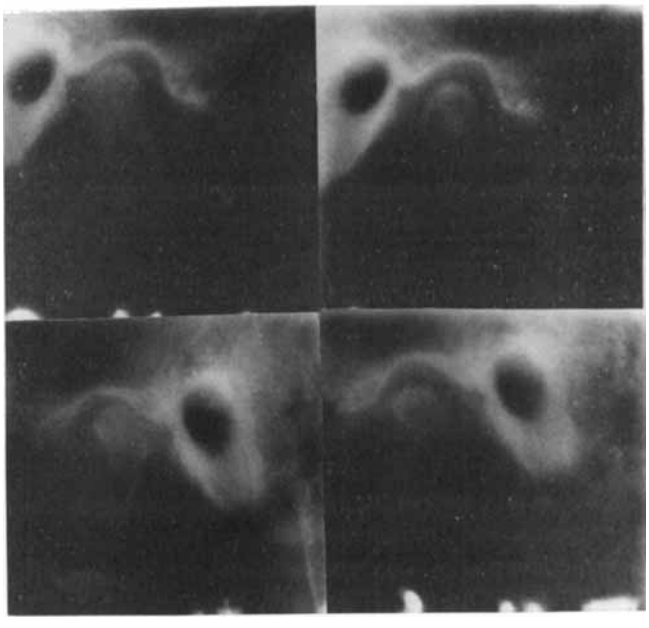

Fig. 5. Tomogram of the right and left temporomandibular joints with the old dentures in occlusion (left) and the new dentures in occlusion (right). Six mm increase in vertical dimension. The condyles are displaced distally bilaterally with the old dentures in occlusion. After the increase in vertical dimension with the new dentures in occlusion, the position of the condyle on the left side (upper right) returned to normal while the condyle on the right side (lower right) took an anterior and slightly inferior position. Same case as in Fig. 1.

Table V. *Means ($\bar{x}$), standard deviations ($S.D._k$), and ranges for the width of the intra-articular space at the points P, C and A after an increase in vertical dimension less than or equal to the mean for the case series compared to those with increases in vertical dimension above the mean*

Length	N	Increase in vertical dimension $\leq$ 4.3 mm $\bar{x}$	$S.D._k$	range	N	Increase in vertical dimension $>$ 4.3 mm $\bar{x}$	$S.D._k$	range	Significance level t-value	
P left	14	1.8	1.0	0.1—3.7	11	3.0	2.1	1.6— 8.9	t = —2.03	not significant
P right	14	2.0	1.2	0.4—4.5	10	2.6	1.4	1.1—11.1	t = —1.01	not significant
C left	14	3.0	1.9	0.1—6.9	12	3.3	1.8	1.8— 8.3	t = —0.32	not significant
C right	14	2.7	1.3	0.8—5.0	10	2.4	0.9	1.1—10.4	t = 0.53	not significant
A left	13	2.5	1.2	0 —5.0	12	2.4	0.8	1.4— 4.1	t = 0.38	not significant
A right	13	3.0	1.0	1.4—4.8	11	2.0	0.5	1.1— 2.6	t = 3.21**	significant

in place a comparison was made between the increase in vertical dimension and the change in width of the joint space on inserting the new dentures (Table VI). There was on average a greater increase in width of the joint space for the distances involving P and C, and a greater reduction for those involving A, in the subjects with a large than in those with a small increase in vertical dimension. The range was, however, extremely large within both groups, but greatest for those with the largest increase in the vertical dimension in the anterior segments of the face — but the opposite relationship was also observed. Nor were the differences in the means significant. No differences between the right and left sides were noted in this respect.

The association between the increase in vertical dimension in the anterior segment of the face and changes in width of the intra-articular space was also examined by correlation analysis (Table

Table VI. *Means ($\bar{x}$), standard deviations ($S.D._k$), and ranges for the differences in the widths of the intra-articular space at the points P, C and A with the new and the old dentures (new minus old) after an increase in vertical dimension less than or equal to the mean for the case series compared to those with increases in vertical dimension above the mean*

Lengt	N	Increase in vertical dimension $\leq$ 4.3 mm $\bar{x}$	$S.D._k$	range	N	Increase in vertical dimension $>$ 4.3 mm $\bar{x}$	$S.D._k$	range	Significance level t-value	
P left	14	0.3	0.7	—0.2—2.0	11	1.1	2.0	—0.6—6.7	t = —1.35	not significant
P right	14	0.4	0.5	0 —1.4	11	1.1	1.6	—0.1—4.6	t = —1.54	not significant
C left	14	0.6	0.9	—0.2—2.6	12	0.9	1.5	—0.9—5.3	t = —0.62	not significant
C right	14	0.3	0.5	—0.5—1.4	11	0.9	1.3	—0.5—4.4	t = —1.58	not significant
A left	13	—0.1	0.3	—0.8—0.4	12	—0.2	0.4	—1.2—0	t = 0.08	not significant
A right	13	0	0.5	—0.7—1.0	11	—0.2	0.5	—1.2—0.4	t = 0.89	not significant

VII). The extremely low correlation coefficients indicate that even considerable changes in the morphologic face height (Figs. 7 & 8; Table III) with the new dentures did not necessarily affect the width of the intra-articular space.

The relationship between the width of the joint space for the distances involving P, C and A with the old and new dentures was examined in the same subjects to bring to light any effect of the increase in vertical dimension on the width of the intra-articular space and to ascertain whether the changes are correlated to the initial position of the mandibular condyles. The results are presented in Table VIII. The consistently high and positive correlation coefficients indicate that in most of the subjects the width of the joint space did not change on inserting the new dentures (Figs. 4 & 6—8). This relationship was

Table VII. *Correlation coefficients for the comparisons between the increase in the vertical dimension with the new dentures and the differences between the widths of the intra-articular lengths at P, C and A with the new dentures in occlusion and those with the old dentures in occlusion*

Left			Right		
P	C	A	P	C	A
0.23	0.17	—0.04	0.33	0.33	—0.05

Table VIII. *Correlation coefficients for the comparisons between the widths of the intra-articular space at P, C and A with the old dentures in occlusion and those with the new dentures in occlusion*

Left			Right		
P	C	A	P	C	A
0.52**	0.76***	0.95***	0.79***	0.89***	0.88***

Table IX. *The mean absolute differences ($\bar{d}$) between the width of the intra-articular space at P, C and A on the left and those on the right side, the standard deviations ($S.D._k$) and the ranges for both the old and the new dentures in occlusion, lengths in mm*

	P			C			A		
	$\bar{d}$	$S.D._k$	range	$\bar{d}$	$S.D._k$	range	$\bar{d}$	$S.D._k$	range
Old denture	0.8	0.8	0.1—4.3	0.8	0.7	0—3.0	0.8	0.8	0.1—3.3
New denture	0.8	0.7	0 —2.6	0.8	0.7	0—2.6	0.7	0.6	0 —2.7

Table X. *Correlation coefficients for the comparisons between the width of the intra-articular space at P, C and A on the left side with those on the right with both the old and the new dentures in occlusion*

Old dentures			New dentures		
P	C	A	P	C	A
0.60*	0.65***	0.48*	0.67***	0.76***	0.51*

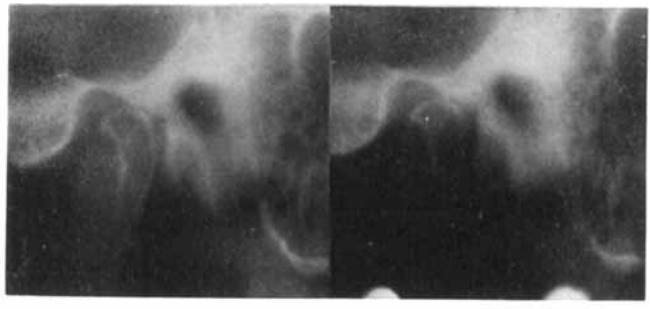

Fig. 6 Tomogram of the right temporomandibular joint. Increase in vertical dimension 3.1 mm. The strongly distal displacement of the condyle with the old dentures (left) is unchanged with the new dentures (right). The intra-articular space is almost entirely reduced distally.

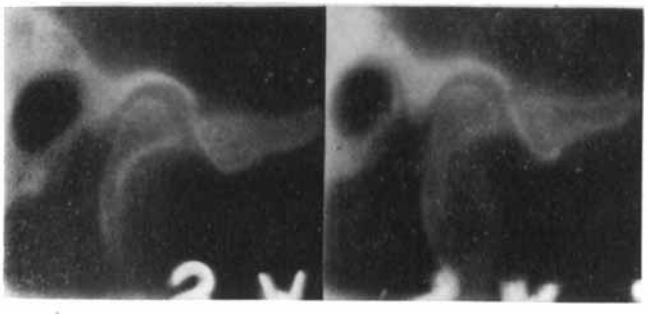

Fig. 7. Tomogram of the left temporomandibular joint. Increase in vertical dimension 7.2 mm. No change in the widt of the intra-articular space width the new dentures in occlusion (right).

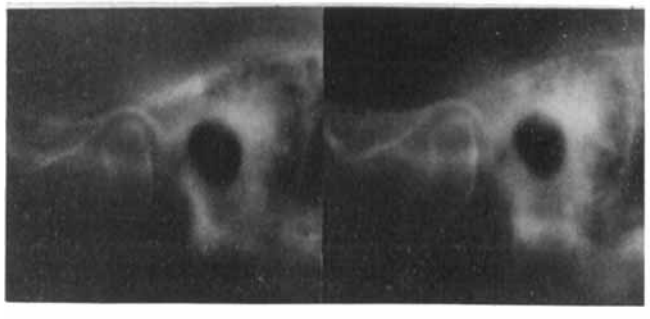

Fig. 8 Tomogram of the right temporomandibular joint. Increase in vertical dimension 9.8 mm. There is no difference between the condyle position with the old dentures (left) and that with the new dentures in occlusion (right). Reduced intra-articular space.

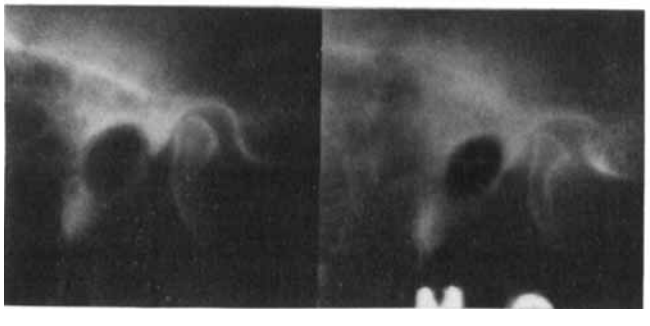

Fig. 9. Tomogram of left temporomandibular joint with the new dentures in occlusion. The roentgenogram sections were made through the center of the condyle (left) and 4 mm medial of center. Increase in vertical dimension 0.6 mm. The condyle is displaced and the intra-articular space markedly reduced. No difference in the width of the intra-articular space between the two sections.

Table XI. *Means ($\bar{x}$), standard deviations ($S.D._k$) and ranges for the width of the intra-articular space at P, C and A with the old dentures. The case series has been divided into two groups according to the age of the old denture, the division being made at the mean for the entire series, 13.5 years*

Length	N	Old dentures less than 13.5 years old $\bar{x}$	$S.D._k$	range	N	Old dentures more than 13.5 years old $\bar{x}$	$S.D._k$	range	Significance level t-value
P left	11	1.6	1.1	0.3—4.2	15	1.7	0.9	1.0—3.8	t = —0.44 not significant
P right	10	2.3	2.1	0 —6.5	15	1.6	0.9	0.4—3.6	t = 1.11 not significant
C left	11	2.3	1.0	0.3—3.5	15	2.6	1.3	1.4—5.9	t = —0.67 not significant
C right	10	2.4	1.7	0.6—6.0	15	2.3	1.1	0.6—4.2	t = 0.14 not significant
A left	11	2.5	1.3	0 —4.6	15	2.5	0.9	0.7—4.1	t = 0.04 not significant
A right	10	2.7	1.5	0.8—5.5	15	2.4	0.7	1.0—3.4	t = 0.44 not significant

also examined by comparing the mean differences in width of the joint space for the right and left sides at points P, C and A with the old and new dentures in place (Table IX). The absolute difference in the width of the joint space on the two sides was constant. The correlation coefficients for the relationship between the width of the intra-articular space on the two sides with the old and with the new dentures in occlusion were also of the same order of magnitude, irrespective of the fact that new dentures were inserted (Table X).

To examine more closely the total effect of the denture-wearing period on the width of the intra-articular space the coefficients of correlations between the width of the intra-articular space at points P, C and A and the period the subjects had worn their dentures were calculated; there was no evident association. Nor was there any association between the width of the joint space and the period the latest denture had been worn (Table XI). The inter-subject variation was fairly large, and in general largest for the group of patients wearing their latest denture for a shorter time than the mean for the whole series.

DISCUSSION

The patients in the present study reported no acute symptoms of the temporomandibular joints. No examination of the joints and muscles was performed, this not being covered by the object of the study.

The registration of the vertical dimension and the retruded occlusal position was carried out by the conventional methods (*Östlund*, 1968; *Boucher*, 1970). The results obtained in this study are therefore probably representative of the effect generally obtained in the region of the temporomandibular joints with these methods.

The precision of the measurements performed on the profile radiographs and tomograms was examined for the distances nasion—gnathion, P, C and A (Table II). The measurement error was small, particularly for N—Gn, P and A, compared with the variation in the total width of the

intra-articular space and with the variation in the difference in width of the joint space between the old and new dentures. The measurement errors, including identification of the anatomic points, therefore cannot have appreciably affected the results.

Discrepancies between tomograms taken with the old and the new dentures in the mouth — the result of manipulation when the dentures were changed — were, due to the large number of exposures performed, not examined closely for ethical reasons. The firm fixation of the head against the object table of the tomograph during the exposure probably diminished this conceivable source of error. As *Eckerdal* (1973) has shown nor do small differences in the depth of the section in the central part of the temporomandibular joint appreciably change the width of the intra-articular space (Fig. 9).

In model experiments *Eckerdal* (1973) has shown that the reproducibility of the anatomic details of the temporomandibular joint is extremely good for the tomographic method and the section depth used here. A small distortion of the tomographic image is, however, inevitable. Since the pattern of distortion should be the same with the new as the old dentures in the mouth, the image distortion is of no significance for the measurements performed within the same joint — as is confirmed indirectly by the correlation coefficients in Table VIII. In addition the examined changes in the width of the joint space and the face height are relative and unaffected by individual differences in the anatomic appearance of the joint.

In the insertion of the new dentures there was no significant difference in the increase in vertical dimension between the group wearing the latest dentures for more and the group wearing them for less than 13.5 years (the mean for the whole series). On the contrary, a weak association ($P < 0.05$) showed that the increase in vertical dimension was on average smaller for the former group. From the published studies on resorption of the alveolar process in full denture wearers (*Carlsson*, 1967; *Tallgren*, 1970) it would seem reasonable to suppose that the resorption was greatest, and hence that the face height decreased most, in the group wearing their dentures for longer than the average time. Even so, the increase in vertical dimension, as reflected in the nasion—gnathion distance, was not greater than for the other group. This may be due to a gradual change in muscle tone with the reduction in the morphologic face height, a change in the postural and a likewise gradual change in the patients' view on the appearance. All these factors may have influenced on the operator during the determination of the vertical dimension.

The increase in vertical dimension measured in the anterior segment of the face resulted in, on average, a small change in the width of the intra-articular space, even though in a few patients large changes were recorded (Fig. 5).

The results show consistently that even quite large changes in the morphologic face height on inserting the new dentures did not affect the width of the intra-articular space. The neglible changes in the width of the intra-articular space after insertion of new dentures indicate a rotation of the mandibular head at the registration procedure, and that the jaw relations in the molar regions were not affected to any noticeably degree. It would be of great value to be able to examine directly the effect of a change in vertical dimension in the anterior and lateral segments on the position of the condyles in the mandibular fossae.

The observed values of the width of the joint space in Table III show that the intra-articular space was smaller in the patients that had worn their dentures over a fairly long period than in persons with natural teeth, and that the condyles were on the average displaced distally (*Lundberg & Welander*, 1970).

The close correlations between the width of the joint space with the old and the new dentures implies, for instance, that when the intra-articular space was small and the mandibular head had assumed an unfavourable position in the mandibular fossa with the old dentures in occlusion, this situation usually did not change when the new dentures were inserted (Figs. 4 and 6—8). It may be mentioned that radiographically demonstrable arthrotic changes in the form of a reduction in the width of the intra-articular space and change in shape of the condyle and fossa were found in 12 patients (44 per cent); this is consistent with clinical observations. *Bergman & Carlsson*, (1972) have reported that 25 per cent of a full denture series complained of symptoms pointing to functional disorders of the masticatory apparatus. In clinical studies on full dentures patients *Agerberg et al.* (1970) and *Hansson & Öberg* (1971) found a high frequency of pain dysfunction of the masticatory apparatus. As mentioned earlier *Öberg et al.* (1971) found in an autopsy series a high frequency of arthrosis in edentulous patients. No longitudinal study of the effect of full denture therapy on the width of the articular space has been published. On the basis of the above-mentioned studies and the results of the present investigation it would seem justified to stress the importance of further studies from the aspect of stomatognathic physiology and radiography in the examination and diagnosis in full-denture patients.

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