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THE TEMPOROMANDIBULAR JOINT
A MORPHOLOGIC STUDY ON A HUMAN AUTOPSY MATERIAL

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INTRODUCTION

Masticatory dysfunction with resting and functional pain in the temporomandibular joints and jaw muscles as well as reduced mobility of the mandible is common. The etiology and pathogenesis of such functional disorders are often obscure and probably usually complex.

The role played by diseases of the actual temporomandibular joints in the causation of the symptoms is not properly understood. This uncertainty is largely due to lack of sufficient knowledge of the physiological aging changes and patho-anatomy of the joint. Though such knowledge can probably be obtained by systematic post mortem examinations, only few such studies have been published. *Bauer* (1932, 1941) described the microscopic findings in 42 temporomandibular joints in 25 subjects, aged 3 months to 81 years. Most of the joints showed »traumatic changes» of varying severity. A description of 300 temporomandibular joints of different ages and examined by mainly conventional histological methods has been published by *Steinhardt* (1934). In his investigation where the main purpose was to study the shape of the joints for any correlation with the type of dentition, »osteoarthritic» changes were often seen especially in edentulous subjects. *Macalister* (1954) histologically examined 69 joints from subjects, aged 16 to 86 years, and

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found microscopic abnormalities in 60. The severity of the changes increased with age. The most advanced changes were found in women. In an investigation of both joints from 45 »cadavers» *Coleman* and *Weisengreen* (1955) found comprehensive extensive »degenerative changes» in one or both disks in 22 %. The micro-morphologic basis of remodelling and of »osteoarthritis» of the temporomandibular joints has been studied with a histologic and softmicroradiographic technique by *Blackwood* (1963, 1966) and histologically by *Moffett et al.* (1964). Blackwood examined 530 temporomandibular joints of different ages. 80 per cent of the subjects over 40 years were edentulous, and only 6 per cent had »something approaching an adequate natural dentition». Moffett and coworkers carried out their investigation on a relatively small series consisting of joints from 34 »anatomy cadavers», aged 45 to 81 years. It appears that joints of gross normal appearance were not examined further.

The aim of these investigations was not to chart pure aging changes of the temporomandibular joint, and the studies did not yield sufficient data to allow any conclusions about the significance of the dentition in the remodelling or in arthrosis (osteoarthritis) of the temporomandibular joint. It also appears that none of the investigations referred to above included systematic gross examination of the various components of the joint.

It is thus obvious that further investigations on autopsy material should be able to yield valuable information on the postnatal development and aging changes of the temporomandibular joint and thereby contribute to elucidation of the etiology and pathogenesis of diseases of the joint and of any correlation between type of dentition and temporomandibular joint arthrosis.

It was therefore decided to examine the temporomandibular joint in cadavers with the use of various histotechnical methods. In the present investigation the various components of the joint were examined macroscopically in subjects of different ages and with different well defined types of dentition.

MATERIAL AND METHODS

It was planned to carry out the investigation on joints from individuals of both sexes and of even distribution in respect of age and 3 types of dentitions:

I complete or almost complete set of teeth with bilateral molar support,
II considerable loss of teeth, reduced dentition without molar support, and
III edentulous, with or without complete dentures.

Only individuals without known diseases capable of influencing joint tissues were accepted. By the end of the collection period 115 joints had been obtained, but not of quite the desired age and sex distribution (Table I).

Table I.

Material grouped according to sex, age and type of dentition

Type of dentition	Sex	Age groups 0—9	10—19	20—29	30—39	40—49	50—59	60—69	70—
I	F	3	4	3	1	2	1	1	0
	M	5	1	3	4	4	3	3	2
II	F	—	—	2	1	2	4	2	1
	M	—	—	4	2	5	7	5	8
III	F	—	—	1	2	2	4	3	7
	M	—	—	1	0	2	1	3	6
		8	5	14	10	17	20	17	24

Specimens comprising the area of the right temporomandibular joint were removed at necropsy. The joint was dissected free and the condyle, temporal component and disk were recorded by measurement, description, drawing and photography.

Sizes of joint components

The largest antero-posterior and medio-lateral diameters of the condyle and of the articular surface of the temporal component were measured to the nearest 0.5 mm with slide calipers. The lowest anterior and posterior level of the articular surface of the condyle, *i.e.* superior level of capsular attachment, was determined by measuring the projected distance to the highest point of the condyloid process (Fig. 1).

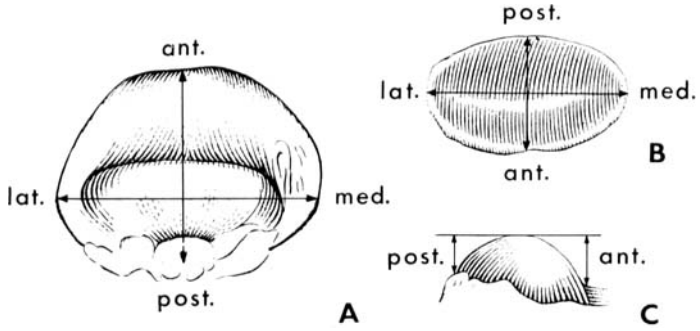


Fig. 1. Schematic drawings showing the measuring points on the joint components. Temporal component seen from below (A) and condyle seen from above (B) with antero-posterior and medio-lateral lines of measurement. Condyle seen from the side (C) with lines of measurement from the lowest level of the articular surface anteriorly and posteriorly, respectively to a tangent through the uppermost point of the condyle.

General shape of joint components

The condyles and articular tubercles of the temporal components were assigned according to their general appearance to one or the other of the following groups:

Condyle

Superior medio-lateral outline of the condyle; anterior view of the condyle.

A 1. Rounded or slightly convex. Fig. 2A
A 2. Largely plane (straight). Fig. 2B
A 3. Ridge-shaped (inverted V-shaped). Fig. 2C
A 4. Other shapes

The horizontal outline of the condyle; superior view of the condyle.

B 1. Oblong. Shorter antero-posteriorly (a-p) than mediolaterally (m-l) [(a-p) $< \frac{1}{2}$ (m-l)]. Fig. 2D
B 2. Rounded to oval [(a-p) $\geq \frac{1}{2}$ (m-l)]. Fig. 2E
B 3. Tapering laterally, pear-shaped. Fig. 2F
B 4. Tapering medially, pear-shaped
B 5. Other shapes.

The cases were also classified according to the relationship between the size of the condyle in antero-posterior and in mediolateral direction.

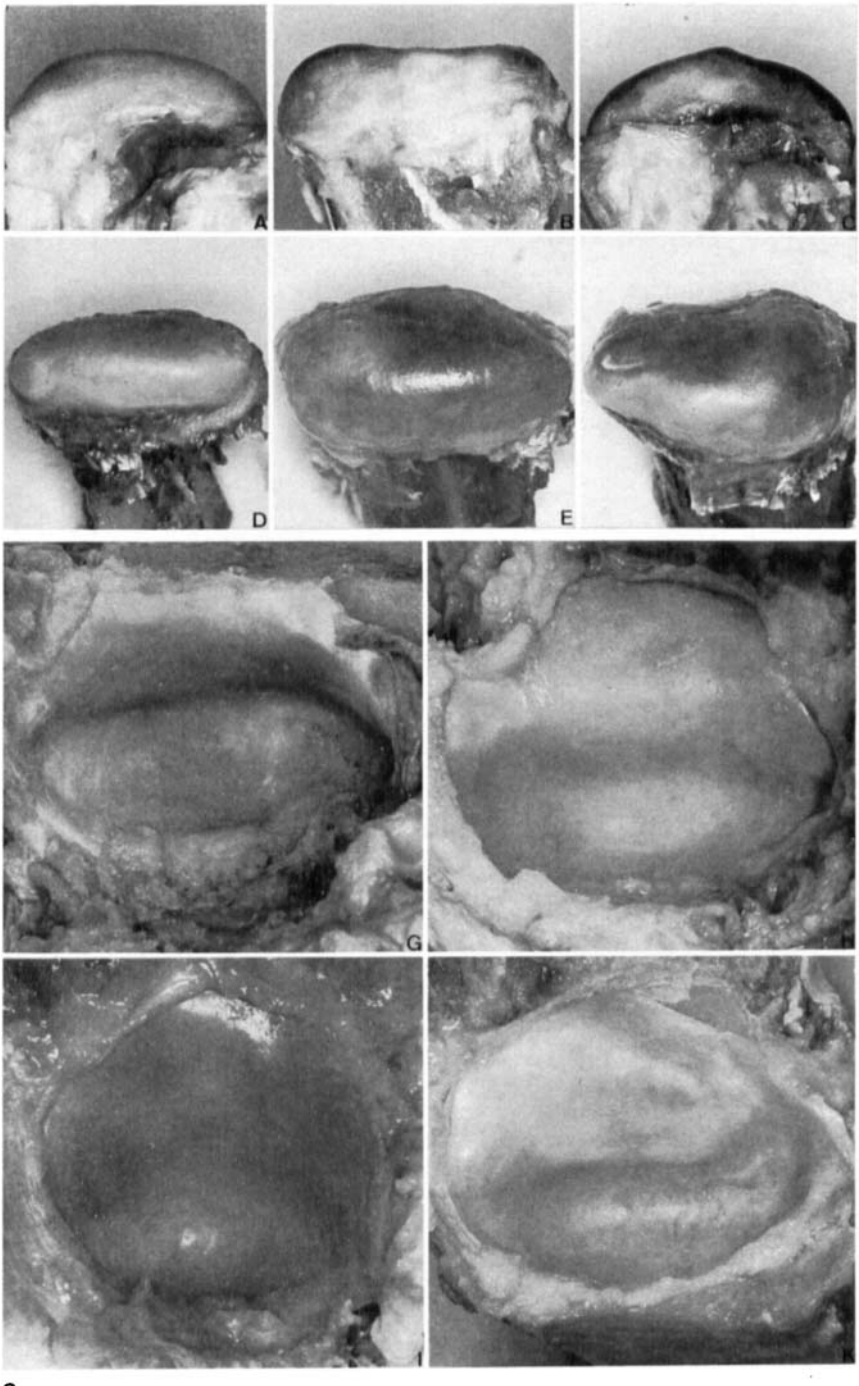
C 1. Condyle where (a-p) $< \frac{1}{2}$ (m-l)
C 2. Condyle where (a-p) $\geq \frac{1}{2}$ (m-l)

Articular tubercle of the temporal component

The inferior medio-lateral outline of the tubercle; anterior view of the tubercle.

D 1. Slighty concave. Fig. 2G
D 2. Largely plane (straight). Fig. 2H
D 3. Very concave (inverted V-shaped). Fig. 2I
D 4. Other shapes.

Fig. 2. General appearance of condyle (A—F) and temporal component (G—I) in adult joints. *A—C:* Condyle in anterior view (lateral to left), whose superior outline medio-laterally is: (A) rounded or slightly convex, group A1; (B) largely flat, group A2; (C) ridge-shaped (inverted V-shaped), group A3. *D—F:* Condyle seen from above (anterior part — at bottom, lateral part — to left), whose outline in a horizontal plane is: (D) oblong, group B1; (E) rounded to oval, group B2; (F) tapering laterally (pear-shaped), group B3. *G—I:* Temporal component seen from below (anterior part — at top, lateral part — to left), whose tuberculum articulare in medio-lateral direction has an outline which is: (G) slightly concave, group D1; (H) largely plane (straight), group D2; (I) very concave (inverted V-shaped), group D3. *K* shows a temporal component seen from below (anterior part — at top, lateral part — to left) which as often in adults has a grove in the tuberculum antero-medially.



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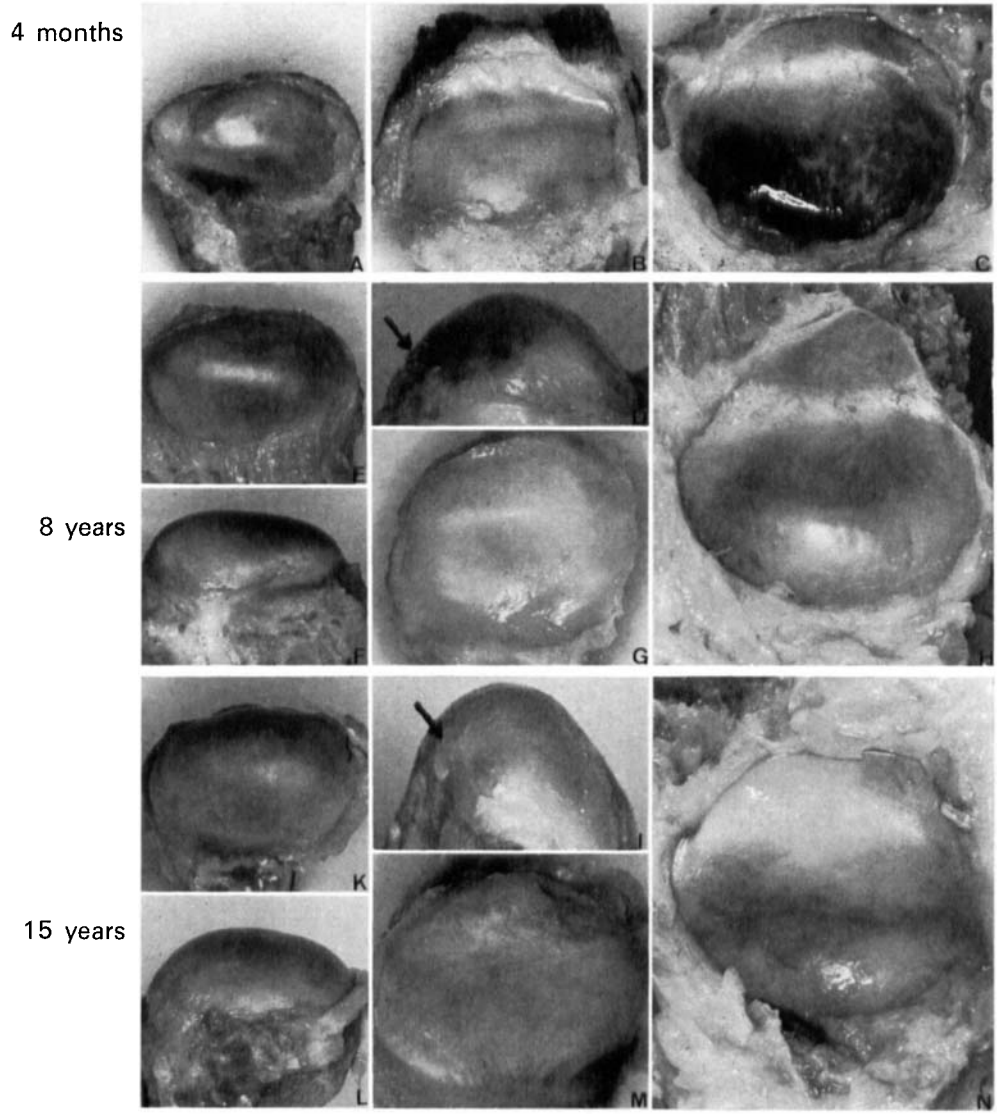

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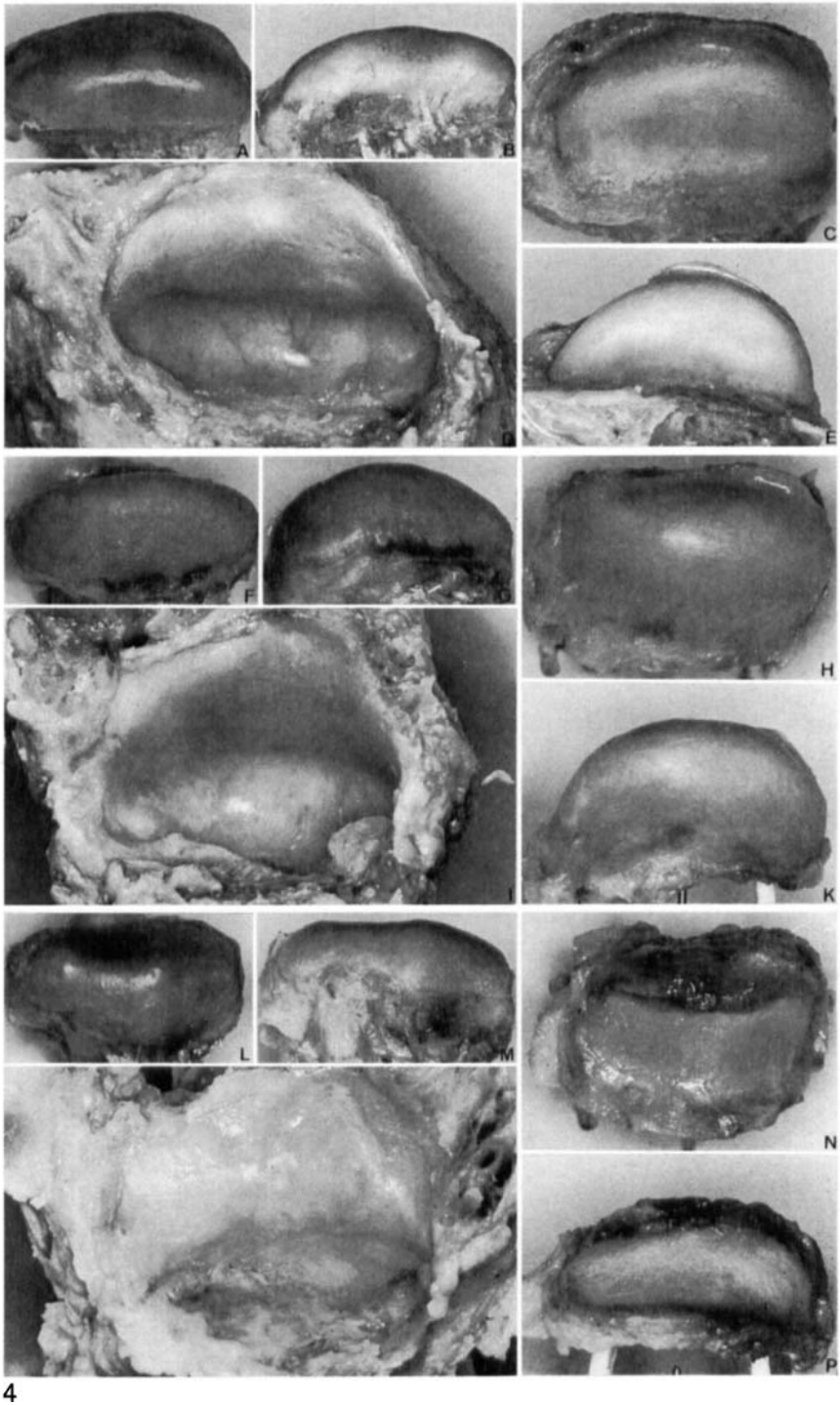
Fig. 3—4. Temporomandibular joints from subjects, aged 4 months to 93 years, without noticable irregularities in shape of the joint components or lesions (arthrotic changes) in joint surface or disk (grade 0, »normal»).
Condyles seen from above, 3A, E, K and 4A, F, L (anterior part — at bottom, lateral part — to left) and in anterior view 3F, L and 4B, G, M (lateral part — to left). Condyles seen from the side 3D, and laterally and somewhat from above 3I, with relatively high level of capsular attachment (outline of articular surface) posteriorly (arrow) which was found in all young individuals. Temporal components seen from below 3C, H, N and 4D, I, O (anterior part — at top, lateral part — to left).
Disks seen from above 3B, G, M and 4C, H, N (anterior part — at bottom, lateral part — to left) and in anterior view 4E, K, P (lateral part — to left).



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Changes in shape and surface lesions

The material was graded in the following way according to marked irregularities in the shape* of the joint components and lesions in articular surfaces including the disk (arthrotic** changes):

Condyle and temporal component

Grade 0 no changes of the type described below under 1, 2, 3 (»normal»). *E.g.* Figs. 3 and 4.

Grade 1 local, marked irregularities of shape (remodellings) without demonstrable lesions (arthrotic changes) of the articular surfaces. *E.g.* Figs. 5A, F, G, H; 7A, C.

Grade 2 local lesions on articular surfaces (arthrotic changes such as erosion, ruggedness, possibly in association with 1). *E.g.* Fig. 8C, G.

Grade 3 extensive lesions of articular surfaces (arthrotic changes) and extensive changes in shape. *E.g.* Figs. 10D, E, G.

Disk

0 absence of changes described below under 1, 2 and 3 (»normal»), *E.g.* Figs. 3 and 4.

1 changes in shape and form, such as marked thinnings and unevenness. *E.g.* Fig. 6D.

2 local lesions; ruggedness of articular surfaces and small perforations (diameter $\leq$ 3 mm). *E.g.* Fig. 7H.

3 extensive lesions; including changes in form and articular surface with large perforations (diameter $>$ 3 mm). *E.g.* Fig. 10B.

Localisation

Lesions of the articular surfaces including the disk were classified according to size and localisation in the following way.

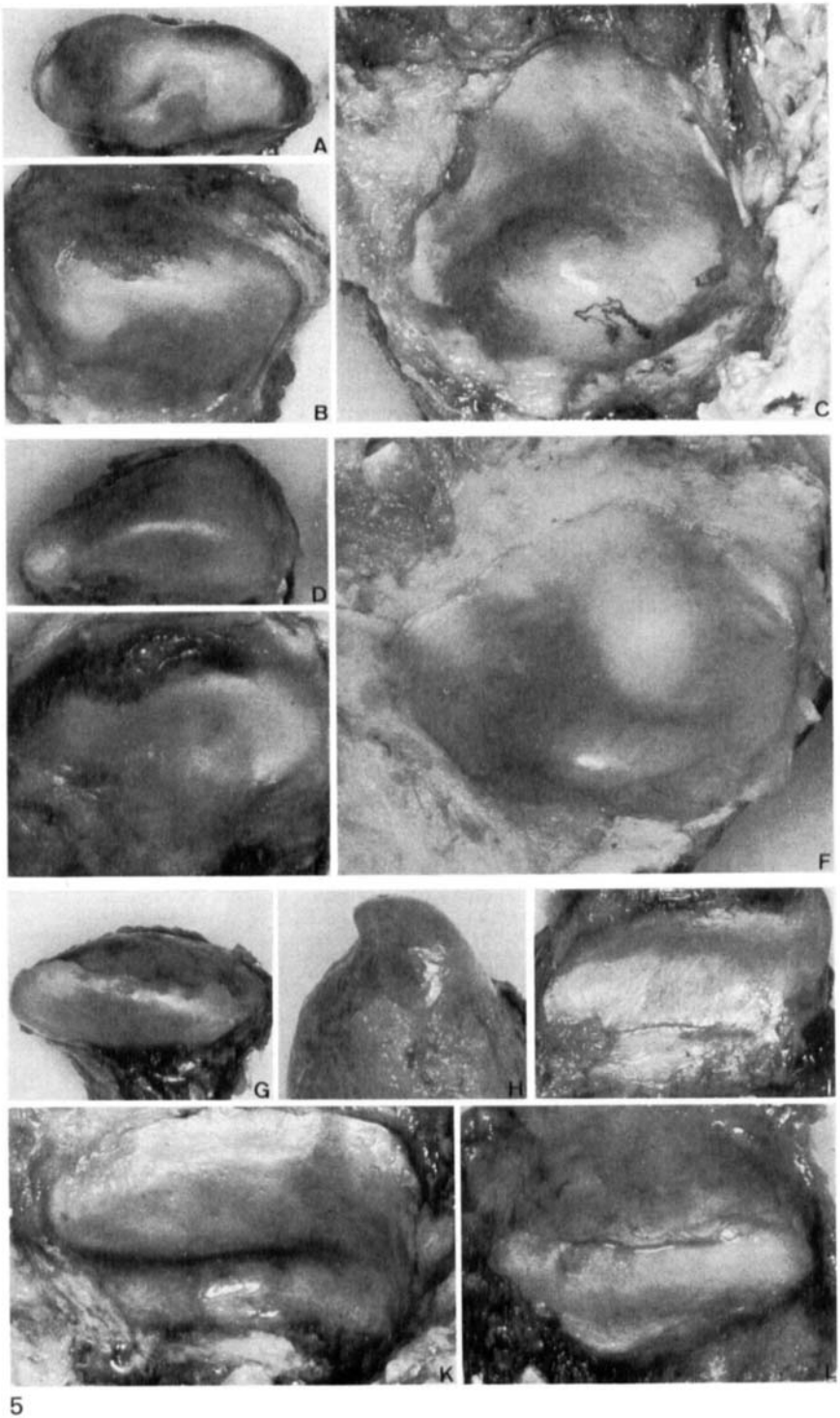
1. Local: a. lateral; b. central; c. medial. *E.g.* Figs 7–9.
2. Extensive. *E.g.* Fig. 10.

*) progressive, peripheral and regressive remodelling according to Johnson (1962).
**) osteoarthritic or, according to Sokoloff (1969), degenerative changes.

Fig. 5—6. Temporomandibular joints without lesions (arthrotic changes) on joint surfaces or disk, but with one or more joint components showing more or less common marked irregularities in shape (remodellings). Unless otherwise stated, the condyles and disks are seen from above (anterior part — at bottom, lateral part — to left) and the temporal components from below (anterior part — at top, lateral part — to left).
5A—C: Temporomandibular joint where condyle (A) and temporal component (C) are moderately remodelled. *D—F:* Joint where the tubercle shows considerable, gently rounded (progressive) remodelling (F) with corresponding concavity in the upper surface of the disk (E). *G—L:* Condyle in G, which seen from the side in H, was found, as in a number of cases, to have irregularity in his shape (remodelling) situated postero-superiorly. The lower surface (L) of the disk has adapted itself to this irregular crest. *6A—D:* Condyle, which in B is seen in anterior view (lateral part — to left) and in C from the side has, like the disk (D) shows, clear changes in shape. (Compare 5G, H). The temporal component showed no irregularities. *E—H:* Condyle, which in F is seen in anterior view (lateral part — to left) and in G from the side is postero-superiorly knotty. The tubercles had formed impressions in the lower surface of the disk while its upper surface was largely flat with only a small fold laterally (H). The temporal component showed no noticable irregularities. *I—L:* Condyle (I) shows postero-superiorly a concavity. The disk (K) is shaped to fit the concavity and folded postero-superiorly. These changed areas have evidently pressed against the fossa postero-superiorly (L). *M—O:* In this joint the tubercle (O) shows considerable changes in form (remodellings).

Fig. 7—8. Temporomandibular joints showing largely similar progressive and peripheral remodelling, confined to the lateral part of the joint. The set of reproductions also illustrates different stages of development of local, lateral temporomandibular joint arthrosis. Unless otherwise stated, the condyle and the disk are seen from above (anterior part — at bottom, lateral part — to left) and the temporal component from below (anterior part — at top, lateral part — to left).
7A—C: Joint where the condyle (A), which is seen in anterior view (lateral part — to left), laterally shows peripheral remodelling with flattened articular surface. The disk (B), which is seen in antero-superior view (laterally to left) is thin opposite the remodelled lateral part of the condyle, but shows no arthrotic changes. The temporal component (C), most laterally on the tubercle, shows marked progressive remodelling. This remodelled area is situated opposite the changes in the condyle (remodelling) and disk (thinning) when these joint components have slipped forward a few millimeters on the tubercle from the position in the fossa. *D—F:* This joint shows remodelling similar to that in A—C. The progressive remodelling of the eminence (F) is, however, less marked. The surface laterally on the disk (E), which is seen in anterior view, and the articular surface laterally on the eminence, are somewhat uneven. *G—I:* This and the following joints show arthrotic changes. Opposite the peripheral area of remodelling laterally on the condyle (G) the disk (H) is thin, uneven and perforated.
8A—C: Condyle (A), seen in antero-superior view (laterally to left), shows considerable peripheral remodelling. The disk (B) is laterally uneven and perforated. Laterally on the tubercle (C) is a large arthrotic lesion, situated opposite the area of the changes in shape and surface lesions of the condyle and the disk, when these components have slipped a few millimeters on the tubercle from their position in the fossa.
D—F: Similar changes as in A—C, but the disk perforation (E) is larger and the progressive remodelling of the eminence (F) is more marked. *G—I:* Besides the arthrotic lesions laterally in the disk (H) and on the tubercle (I), those changes seen in A—F, this joint also shows an arthrotic change in the lateral remodelled part of the condyle (G).

Fig. 9. Temporomandibular joints with remodelled areas and local, central arthrosis. Condyles and disks seen from above (anterior part — at bottom, lateral part — to left) and temporal component from below (anterior part — at top, lateral part — to left). *A—C:* Condyle (A) has a shallow concavity postero-superiorly. Disk (B) is shaped to fit this concavity. In this area there is also a fold. Opposite these areas when the condyle and the disk are in position in the fossa (C), there is progressive hard tissue remodelling in the latter. The normally very thin layer of soft tissue is thickened and injured by wear. *D—F:* Condyle (D) has antero-superiorly a button-shaped, progressive remodelling. Centrally on the posterior slope of the tubercle (F) and opposite the progressive remodelling on the condyle there is a low, progressive remodelling. In the central part of the disk (E) situated between the areas undergoing remodelling, is a large, central perforation.



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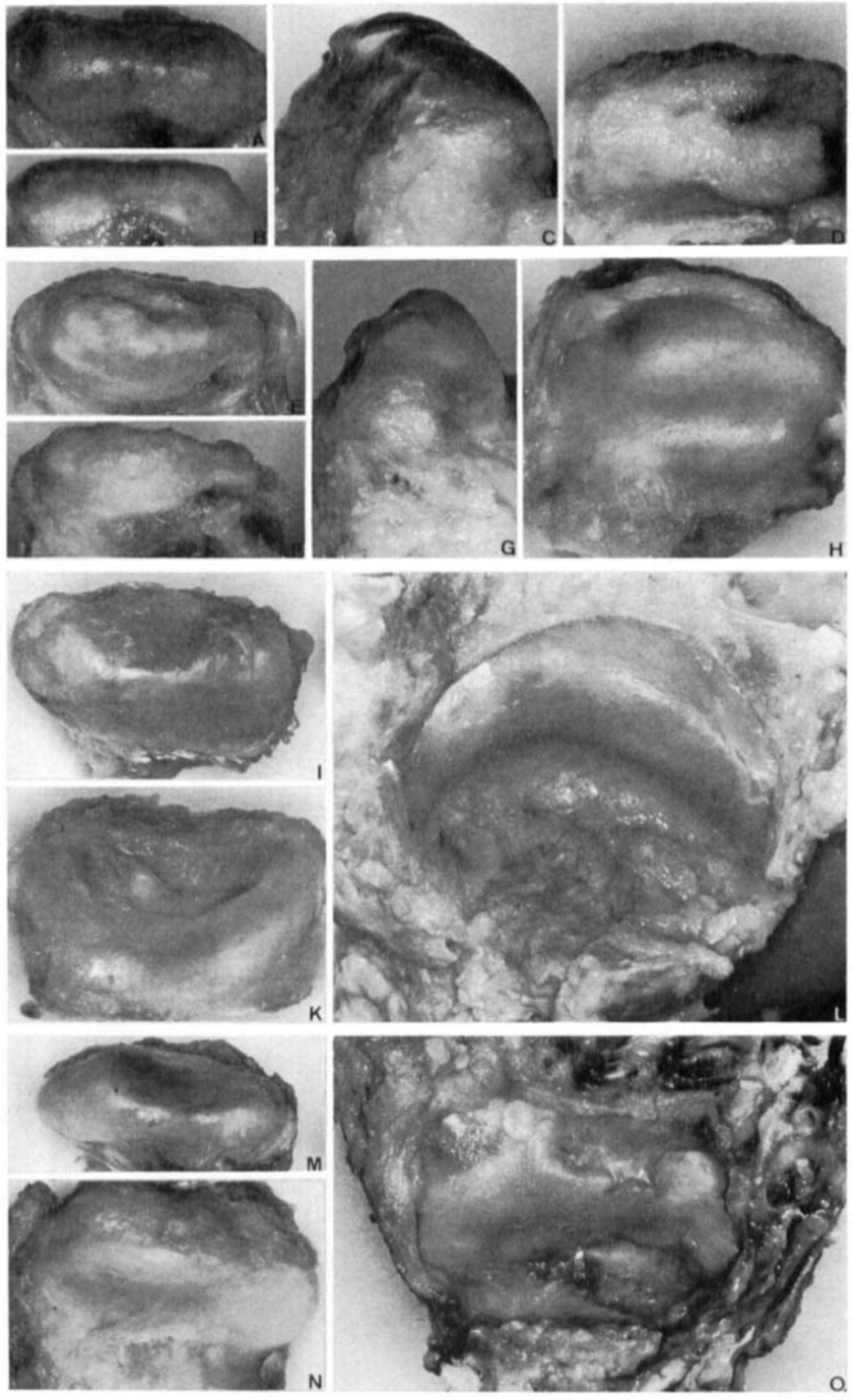
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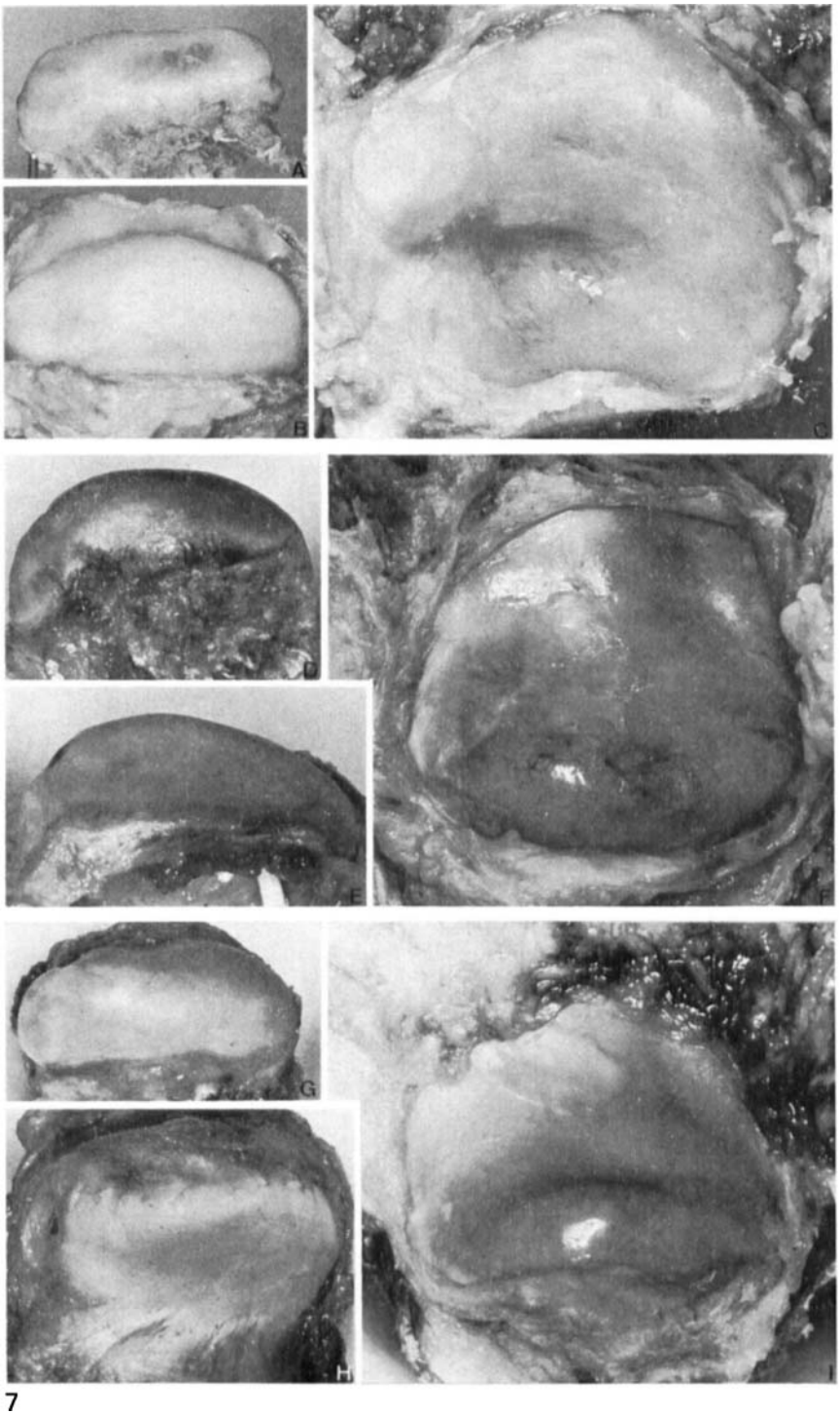

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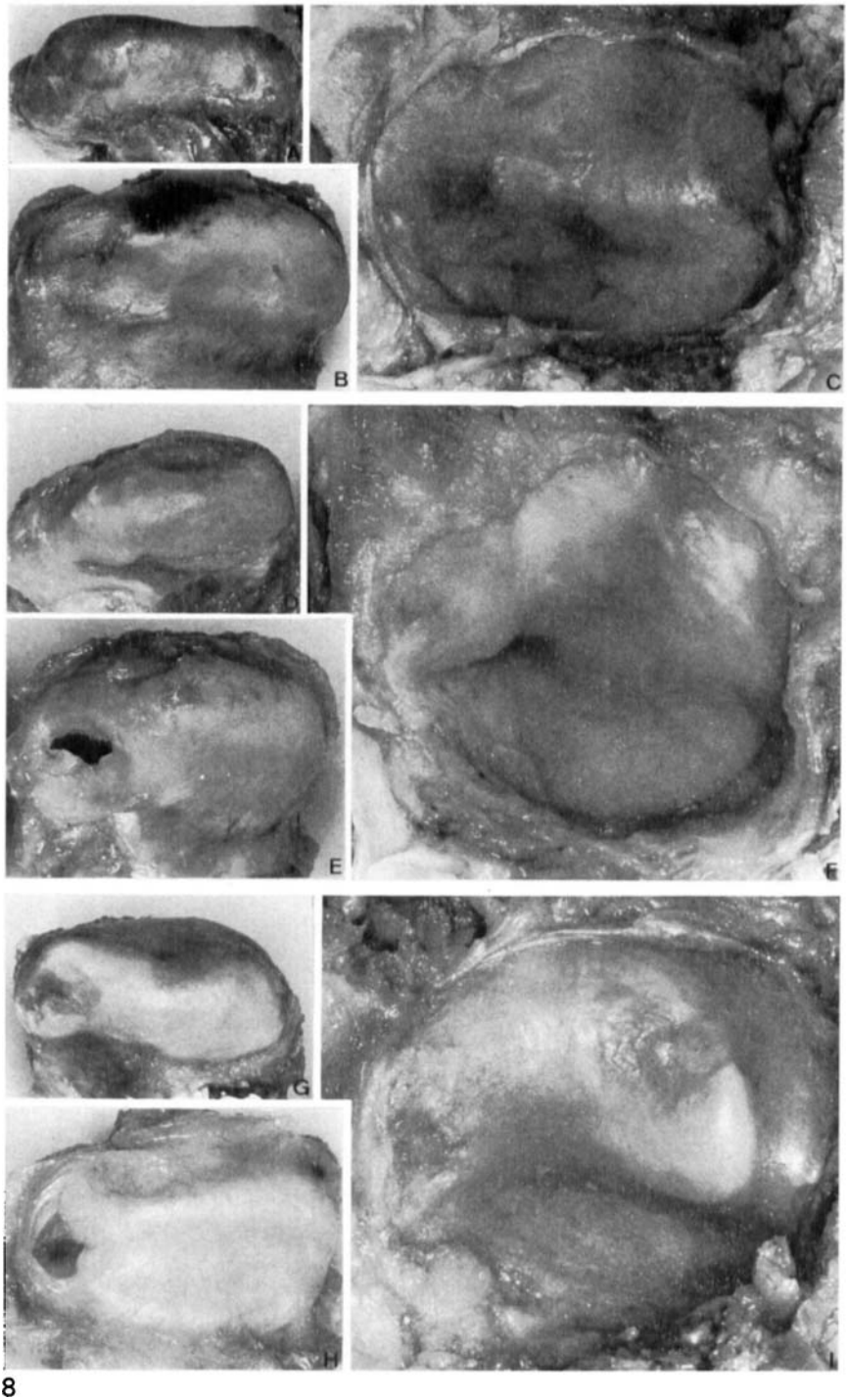

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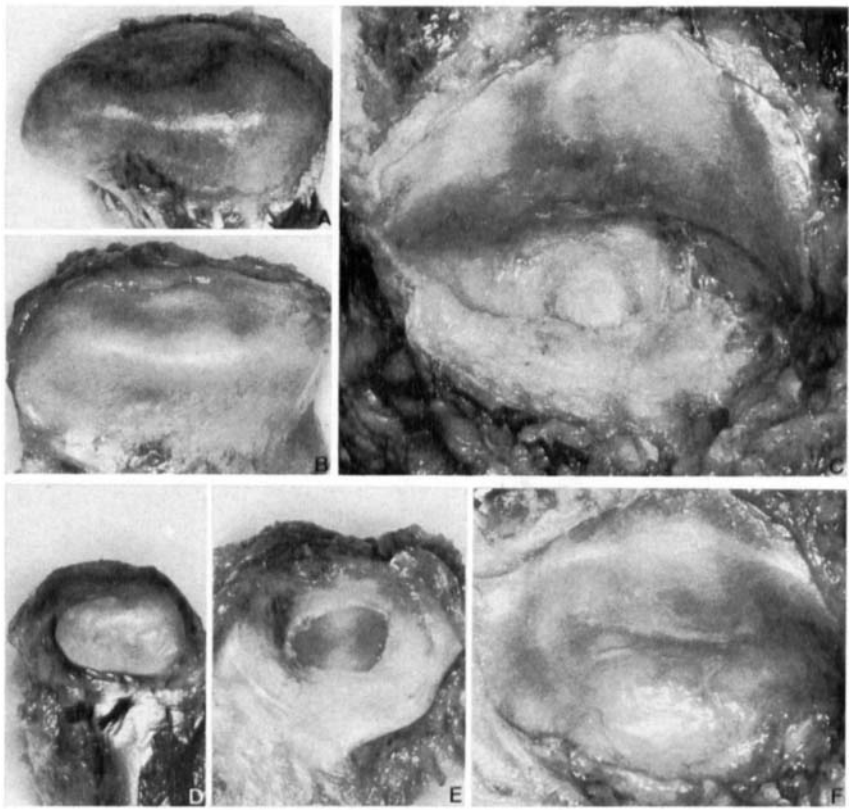
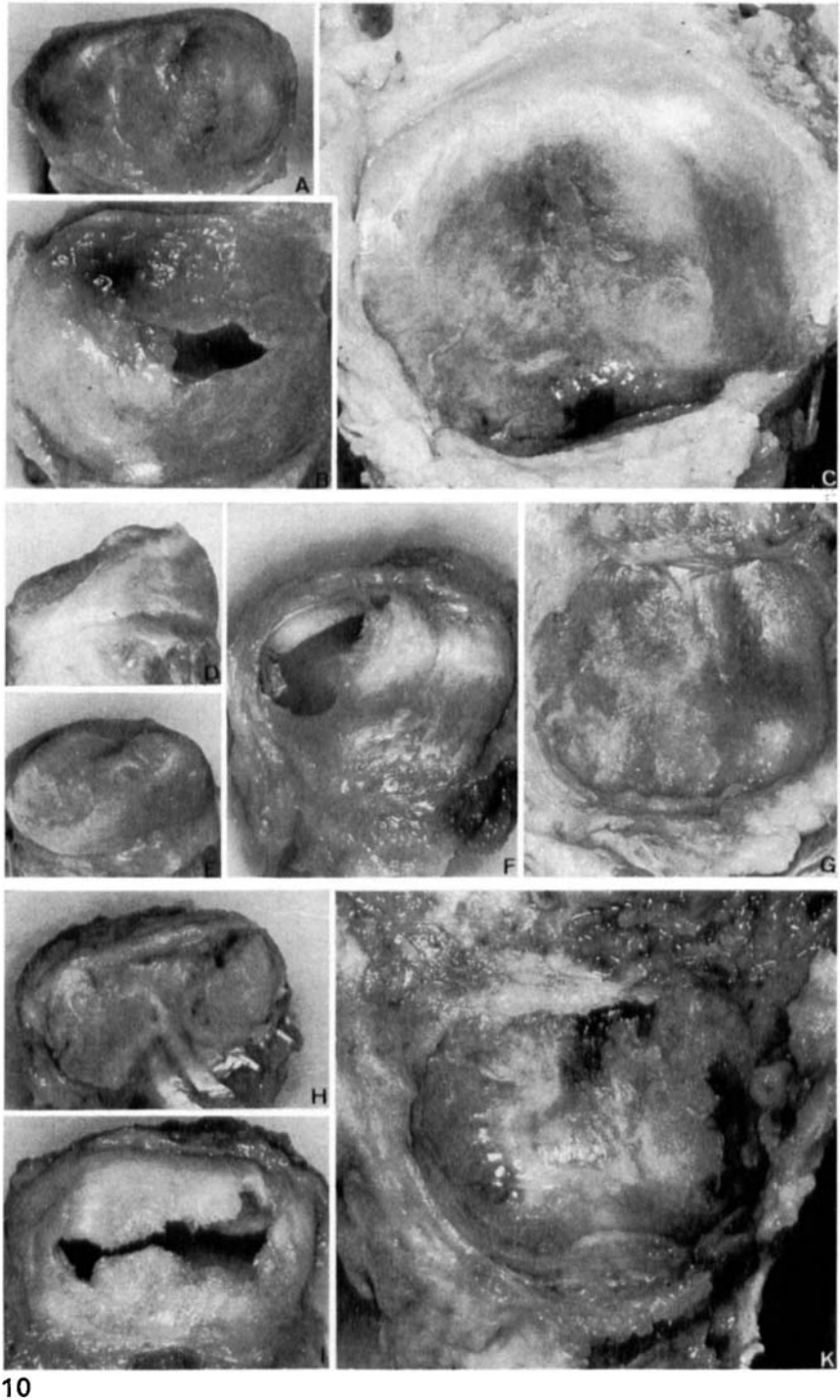


Fig. 10. Temporo mandibular joints with advanced remodelling and extensive arthrosis. Unless otherwise stated the condyle and the disk are seen from above (anterior part — at bottom, lateral part — to left) and the temporal component from below (anterior part — at top, lateral part — to left). *A—C:* Condyle (A) with progressive remodelling of large areas antero-superiorly and minor arthrotic changes. In the disk (B) is an uneven surface and large, central perforation opposite the progressive remodelling. The temporal component (C) is in its central parts flat in antero-posterior direction and shows extensive arthrotic changes. *D—G:* Condyle, which in D is seen in anterior view (laterally to left), and in E from above shows wear over large parts of the superior surface. This surface slopes inferio-laterally. Over the worn area on the condyle the disk (F) has a large perforation. The lateral three fourths of the temporal component are entirely flattened and show advanced arthrotic changes. *H—K:* Practically the entire articular surfaces of the condyle (H) and the temporal component (K) are extensively destroyed. The disk (I) has a large perforation and its surface is uneven. (Possibly arthrotic changes, secondary to systemic disease of the joints).



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RESULTS

Sizes of joint components

The size of the joint varied clearly from one individual to another, but increased, on the average, during the first two decades of life and then particularly in medio-lateral direction (Table II).

From 20 years on the mean values in the various age groups were largely equal (Table III). The sizes of the joint components were not found to vary significantly with type of dentition. The mean for group III was, however, lower than for the other groups. The medio-lateral diameter of the condyle was, on the average, twice as long as its antero-posterior diameter, *viz.* 20 and 10 mm, respectively. Also the medio-lateral diameter of the articular surface of the temporal component was longer than its antero-posterior diameter, but the difference was smaller, *viz.* 23 and 19 mm, respectively. The range of variation was large also in the adult groups. The individual extreme values were 5.5 and 16.0 mm for the antero-posterior and 13.0 and 25.0 for the medio-lateral diameter of the condyle; 12.0 and 23.0 for the antero-posterior and 18.0 and 28.0 for the medio-lateral diameter of the articular surface of the temporal component (Table III). The antero-posterior diameter of the two components did not vary with sex; but the medio-lateral

Table II.

Longest dimensions (mm) of the condyle and of the articular surface of the temporal component in antero-posterior (a-p) and medio-lateral (m-l) direction in the youngest individuals (0—19 years)

	Condyle		Temporal component	
Age	a-p	m-l	a-p	m-l
1 day	5.0	9.0	9.5	10.0
4 months	7.0	12.0	11.5	13.0
1 year 2 months	7.0	10.0	13.0	14.0
1 year 2 months	8.0	12.0	14.0	16.0
1 year 3 months	8.5	15.5	16.0	16.0
5 years	8.0	16.0	13.5	18.0
8 years	8.0	14.0	14.0	16.5
8 years	10.0	16.0	19.0	20.0
10 years	10.0	17.0	19.5	20.5
14 years	9.0	13.0	17.0	17.0
15 years	11.5	18.0	17.0	20.0
18 years	8.5	18.0	17.5	21.0
19 years	9.0	21.5	20.0	25.0

Table III.

Means, $\bar{x}$, and range of variation, R, with extreme values, for measurements of largest diameter of condyle and articular surface of the temporal component in antero-posterior (a-p) and mediolateral (m-l) direction and the lowest level of the articular surface (level of attachment of capsule) anteriorly (a) and posteriorly (p), measured from the highest point of the condyle in mm

Age group years		Condyle		Temporal component		Level of attachment of capsule	
		a - p	m - l	a - p	m - l	a	p
0—9	$\bar{x}$	7.6	12.6	13.9	15.0	4.9	2.1
	R	5.0—10.0	9.0—16.0	9.5—19.0	10.0—20.0	3.5—6.0	1.0—4.0
10—19	$\bar{x}$	9.6	17.5	18.2	20.7	7.6	6.5
	R	9.0—11.5	13.0—21.5	17.0—20.0	17.0—25.0	5.0—11.0	4.5—8.0
20—29	$\bar{x}$	9.8	19.6	18.7	23.3	5.9	8.8
	R	5.5—11.5	16.5—22.5	14.0—22.0	22.0—27.0	4.5—8.0	5.0—11.0
30—39	$\bar{x}$	10.7	19.8	19.5	21.9	6.4	10.4
	R	7.0—13.0	17.0—22.0	16.0—23.0	18.0—23.5	5.5—7.5	6.5—13.5
40—49	$\bar{x}$	9.3	19.6	19.4	22.7	6.4	9.0
	R	5.5—11.5	16.5—24.0	17.0—22.0	20.0—26.0	4.5—9.5	6.5—13.0
50—59	$\bar{x}$	9.3	18.9	19.3	23.3	6.5	9.0
	R	7.0—11.0	13.0—22.0	12.0—22.5	21.5—26.0	4.0—9.0	6.0—11.5
60—69	$\bar{x}$	9.9	20.0	19.4	23.0	6.9	10.0
	R	8.0—12.0	18.0—23.0	14.0—22.0	18.0—28.0	5.0—9.0	9.0—12.5
70—	$\bar{x}$	10.0	20.6	18.4	23.8	6.6	8.8
	R	7.0—16.0	16.0—25.0	12.0—22.0	22.0—27.0	5.0—8.0	6.5—14.0
20—93	$\bar{x}$	9.8	19.8	19.1	23.0	6.5	9.3
	R	5.5—16.0	13.0—25.0	12.0—23.0	18.0—28.0	4.0—9.5	5.0—14.0

diameters were shorter, though not significantly, for women than for men (condyle 19.1 and 20.3 mm, respectively; articular surface of the temporal component 22.3 and 23.4, respectively).

No attempts were made to measure the development or size of the tubercle and fossa.

The outline of the articular surface of the condyle (the superior level of the attachment of the capsule) was high in the youngest children; it was above the medial and lateral poles of the caput and anteriorly it was somewhat lower than posteriorly. The disk was tightly attached to the condyle by the capsule (Fig. 3).

Between the ages of 10 and 19 years the outline of the articular surface was, on the average, at the same level anteriorly as posteriorly (Table III).

Despite considerable individual variation the relation of the outline of the articular surface to the highest point of the condyle and to its poles in adults differed somewhat from that in young individuals (Figs 3 and 4). In ages above 19 years the outline of the articular surface was, on the average, more inferiorly on the posterior surface of the condyle than on its anterior surface (Table III).

The outline of the articular surface anteriorly and posteriorly was not found to vary significantly with type of dentition. In dentition group III, however, the posterior level was somewhat lower than in the other two groups.

In adults the outline of the articular surface of the condyle medially was always situated in the middle of, or below, the pole of the condyle, while laterally in most of the joints it was situated in the middle of the pole, and in the remaining joints roughly equally often above as below the pole.

General shape of joint components

Condyle. In ages below 20 years form A1 was most common, *i.e.* rounded or slightly convex superior outline, as seen in anterior view (Figs. 2A; 3F, L), which characterised 11 (92 %) of the 13 condyles. Form A2, largely flat upper outline (Fig. 2B) was seen in 2 (8 %) joints, while no condyles of types A3 or A4 were observed. In the adults the preponderance of shape A1 was not so marked; 55 % (Fig. 4B, G). This meant a significant difference between the 2 age groups ($p < 0.01$ according to X^2-test). The flat form, A2, was seen in 20 % and A3 (Fig. 2C) and A4 in less than 20 % of the adults (Table IV).

Seen from above, the rounded shape, B2, of the condyle (Figs 2E; 3A, E, K) was commonest in ages below 20 years, namely in 62 %. The distribution between this shape and the oblong shape, B1 (Figs 2D; 4A, F), was relatively even in the adult group, with a certain, but not significant, preponderance for form B1 (36 and 44 %, respectively). Other shapes were much less common (Table IV).

Classification of the material according to the relationship between the antero-posterior and the medio-lateral diameters showed that in ages above 19 years there was an even distribution between the two shapes, C1 and C2 (49 and 51 %, respectively), while in ages below 20 years there was a marked preponderance of shape C2, 85 % against 15 % for C1. The difference between the 2 age groups was significant. In the 0—9 year group all condyles were of type C2.

The smaller variation in the frequencies of the different shapes with sex (Table IV) and type of dentition was never statistically significant.

Temporal component. Seen from below the articular surface of the temporal component was nearly always oval (Figs. 2—4). The medio-lateral dia-

Table IV.

Distribution of condyles according to general shape. A. the superior medio-lateral outline of the condyle, condyle seen in anterior view: A1, rounded or slightly convex; A2, largely plane (straight); A3, ridge-shaped (inverted V-shaped); A4, other shapes. B. horizontal outline of condyle; superior view of the condyle: B1, oblong; B2, rounded to oval; B3, tapering laterally, pear-shaped; B4, tepering medially, pear-shaped; B5 other shapes. C1, comprises condyles where $(a\text{-}p) < \frac{1}{2}(m\text{-}l)$ *and group 2 the remaining cases, i.e.* $(a\text{-}p) \geq \frac{1}{2}(m\text{-}l)$

	0—19 years	20—93 years		
	♂ + ♀ n = 13	♂ n = 63	♀ n = 39	♂ + ♀ n = 102
Shape A1	92	60	47	55
A2	8	22	18	20
A3		7	18	11
A4		12	18	14
Shape B1	15	48	37	44
B2	62	31	46	36
B2	23	10	3	7
B4	—	2	—	1
B5	—	10	14	11
C1	15	55	40	49
C2	85	45	60	51

meter was larger than the antero-posterior in all cases except 4, including 2 below 20 years. In these 4 cases it was equally long antero-posteriorly as medio-laterally, and the articular surface was rounded.

In a newborn the articular surface of the temporal component was largely flat. Between the ages of 4 and 15 months the tubercle was poorly developed (Fig. 3C), between 5 and 8 years the fossa and tubercle had clearly developed, but the tubercle was still fairly flat (Fig. 3H). In the youngest children, including one 5-years old, the transversal axis of the temporal component was inclined with the lateral part more superior than the medial, while in older children and adults it was more horizontal. At 14—15 years the tubercle and the fossa were well developed (Fig. 3N) and in a central sagittal plane the surface of the temporal component was, as in adults, nearly always more or less S-shaped.

In the frontal plane the shape of the tubercle was mostly (77 %) flat (D2; Fig. 2H) in the youngest individuals, but slightly more often concave (D1; Fig. 2G) in the adult group (61 %, Table V). This difference with age was

Table V.

Inferior medio-lateral outline of tuberculum articulare, tuberculum seen in anterior view; distribution of different shapes. D1, slightly concave; D2, largely flat (straight); D3, very concave (inverted V-shaped); D4, other shapes.

	0—19 years	20—93 years		
	♂ + ♀ n = 13	♂ n = 63	♀ n = 39	♂ + ♀ n = 102
Shape D1	23	63	58	61
D2	77	25	21	24
D3		2	6	4
D4		10	15	12

significant. The flat shape (D2) was seen in one fourth (24 %) of the adults, and other forms, D3 (Fig. 2I) and D4, in all together 16%. The small differences in the frequencies of the different shapes of the tubercle with sex (Table V) and type of dentition were never statistically significant.

In about one third of the adults the tubercle showed a clear groove along the medio-anterior outline of the joint surface with a width of up to 20 % of the longest medio-lateral diameter of the tubercle (Fig. 2K) The articular surface of this groove shaped part, as seen with the naked eye, was always even and smooth.

Disk. Seen from above the disk may be described as a rectangle with rounded corners (Figs 3G; 4C, H). In the youngest individuals (1 day and 4 months) the disk was relatively plane (Fig. 3H). In all the other cases it resembled a cloth cap with its largest posterior part, the top, rounded and enclosing the upper part of the condyle (Figs 3G, M; 4C, E, H, K). The anterior, minor part, the visor, was directed anteriorly in under the tubercle of the temporal component. In a band shaped area, extending in mediolateral direction across the antero-superior surface of the condyle, the disk was thin. It increased in thickness peripherally, especially in anterior and posterior direction.

A comparison between the joint components in the different individuals showed that in the adult group there was generally good congruence mediolaterally between the tubercle and the condyle. The condyle appeared most often to fit well into the tubercle when sliding anteriorly. Thus, a condyle convex when seen in anterior view was usually found in association with a concave articular tubercle and a flat condyle with a flat tubercle. In a few

Table VI.

Frequency of changes in shape (remodelling; grade 1) and surface lesions (arthrotic changes), all associated with changes in shape (grades 2 and 3) of the various joint components in different types of dentition in age-classes from 20 years. For definition see text (page 356)

	Age groups	Number and distribution in per cent									Distribution in per cent		
		Group I			Group II			Group III					
		Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3	Grade 1	Grade 2+3	Grade 1+2+3
Temporal component	20—39	2	—	—	3	1	—	1	—	—	25 %	4 %	29 %
	40—59	1	—	—	4	3	1	2	3	1	16 %	22 %	38 %
	60—93	—	—	—	6	1	1	4	5	1	24 %	20 %	44 %
	20—93	11 %		0 %	30 %		16 %	22 %		31 %	23 %	17 %	40 %
Condyle	20—39	1	—	—	2	—	—	2	—	—	21 %	0 %	21 %
	40—59	3	—	—	10	—	1	8	—	—	57 %	3 %	60 %
	60—93	—	—	—	6	—	1	11	1	1	41 %	7 %	49 %
	20—93	15 %		0 %	42 %		5 %	66 %		6 %	42 %	4 %	46 %
Disk	20—39	4	—	—	2	—	—	1	—	—	30 %	0 %	30 %
	40—59	1	2	—	5	2	2	1	3	2	19 %	30 %	49 %
	60—93	—	—	—	5	—	1	3	3	4	20 %	20 %	40 %
	20—93	19 %		7 %	28 %		12 %	16 %		38 %	22 %	19 %	41 %

cases, however, there was incongruence between the shapes of the joint components.

Changes in shape and surface lesions

All temporomandibular joints below 20 years were classified grade 0, *i.e.* no cases with marked local irregularities in the shape of the joint components or lesions on articular surfaces were noted (Fig. 3). The following description thus concerns only ages above 19 years. Examples of the observations made are given in Figs. 4—10.

Changes in shape and surface lesions of different joint components. Appreciable changes in shape (remodelling) and surface lesions (arthrotic changes) (grades 1, 2 and 3 together) were seen in 40 % of the adult temporal components of the joint, in 46 % of the condyles and in 41 % of the disks (Table VI). They were common already in ages 20—39 years, where the corresponding frequencies were 29, 21 and 30 %, respectively. In ages above 39 years changes in shape and surface lesions were together somewhat more common, but no increase in frequency was noted from 40—59 to 69—93 years.

Of these changes, changes in shape alone (grade 1) were predominant in all joint components in age groups below 40 years, while in ages above this limit grade 2 and 3 changes were seen in the temporal component and disk in about half of the joints judged as »abnormal». In the condyles the changes in shape (grade 1) were equally common as in the temporal component and in disk, while surface lesions were seen in only 4 %, compared with 17 and 19 % in the temporal component and disk, respectively. In individuals above 19 with type I dentition 2 disks were found to have grade 2 lesions (small perforations), *i.e.* in 7 % of the adults in group I, while no arthrotic changes (grades 2 and 3) were seen in the temporal or mandibular components of the joint. Changes in shape (grade 1) were demonstrated in a further 19 % of the disks (appreciable thinning, unevenness) and in 11 and 15 %, respectively, in the temporal component and the condyle (Table 6).

In the groups with type II and III dentition the frequency of lesions of the articular surface (grades 2 and 3) were 16 and 31 %, respectively in the temporal component and 5 and 6 % respectively on the condyle; disk perforations of different sizes were seen in 12 and 38 %, respectively. In groups II and III changes in shape (grade 1) alone were demonstrated in the temporal component in 30 and 22 %, respectively; in the condyle in 42 and 66 %, respectively, and in the disk in 28 and 16 %, respectively (Table VI).

Joints with changes in shape and surface lesions. In all together 57 joints, in 62 % of the females and in 52 % of the males, changes of grades 1, 2 or

Table VII

Frequency of joints with surface lesions and diskperforations (grades 2+3) in one or more joint components in different types of dentition in age-classes above 19 years. For definition of types of dentition see text (page 350)

Age groups	Type of dentition			Distribution in per cent
	Group I	Group II	Group III	
20—39	0/11	1/9	0/4	4
40–59	2/10	4/18	5/9	30
60—	0/6	2/16	8/19	24
	7 %	16 %	41 %	

3 were found in at least one of the joint components. Arthrotic lesions graded as 2 or 3, were demonstrated in 22 joints, which constituted 22 % of the entire adult material. 31 % of the women and 15 % of the men had arthrotic changes. This difference with sex was almost significant ($p < 0.05$ according to the X^2-test). No significant difference was found between the changed (grades 1, 2 and 3) and the »normal» joints (grade 0) regarding the general gross appearance of the joint components (A-D).

In age groups 20—39 years, joints with surface lesions were rare (Table VII) and were seen in only one case (4 %), and then in the fossa in a 29 year old subject with type II dentition. In individuals above 39 years the frequency was 27 % with a fairly equal distribution among the 10 year groups. Of 4 joints with extensive lesions, 2 were seen in subjects belonging to the 50—59 year class and 2 in subjects above 70 years.

The frequency of joints with surface lesions, arthrosis, varied considerably with the type of dentition (Table VII). Two (7 %) of the adults with a full set of teeth showed arthrotic changes against 7 (16 %) of those without molar support and 13 (41 %) of the edentulous cases.

According to the X^2-test, the above frequencies varied significantly with type of dentition ($p < 0.01$).

Sites of changes in shape and surface lesions. Of the 22 joints with changes in both surface and shape (grades 2 and 3), 4 showed extensive, severe changes involving all the joint components. In addition to surface lesions there were marked deformations of the temporal and mandibular joint components and large perforations in the disk (Fig. 10).

In 18 cases the arthrotic changes involved smaller parts of the joint components. In these joints with local changes, surface injury was found more

often in the disk (perforations) and the temporal component than in the condyle: in the disk in 14 cases, in the temporal component in 13, and in the condyle in only 1 (Fig. 11).

The local surface lesions were situated laterally in 13 cases, centrally in 5, while no changes at all were seen in the medial parts of the joint (Fig. 11).

In the 13 joints with lateral lesions the disk was invariably perforated. In 9 of these joints the surface of the tubercle showed an injury opposite the perforation, while in one case the tubercle, condyle and disk showed lesions opposite one another. In most cases the tubercle showed a plateau-like structure (progressive remodelling) on the posterior surface, while the condyle was remodelled and mostly flattened (peripheral remodelling) in the area corresponding to the perforation of the disk (Figs 7G–I, 8). In one case this remodelling comprised small spikes laterally on the condyle, fitting into small perforations in the disk.

Of the 5 central lesions, 4 were seen in the deepest part of the fossa (Fig. 9A–C). In these cases there were also distinct changes in shape(progressive remodelling) in the floor of the fossa, an impression in the disk and concavities in the corresponding part of the condyle. The fifth case showed a central perforation in the disk opposite a remarkable remodelled part of the condyle (Fig. 9D–F).

All of these arthrotic joints showed marked articular remodelling. The same types of localised remodelling as those seen in arthrosis were, however, also observed in other joints without coexisting surface lesions (compare Fig. 7A–F with 7G–I and 8).

In some cases irregularities and small excrescences were seen on the postero-superior outline of the condyle, usually in association with an inferiorly situated concavity and impressions and deformation — but not perforations — of the disk (Fig. 5G–L; 6A–I).

DISCUSSION

Though the material was collected over a long period (almost 2 years), the desired even distribution according to sex, age and type of dentition could not be secured. This was mainly because of difficulties in finding elderly individuals with full sets of natural teeth and referable to group I, and younger individuals who were edentulous, group III. The collection was also made difficult by the fact that no cases with known previous diseases possibly capable of influencing joint tissues were accepted.

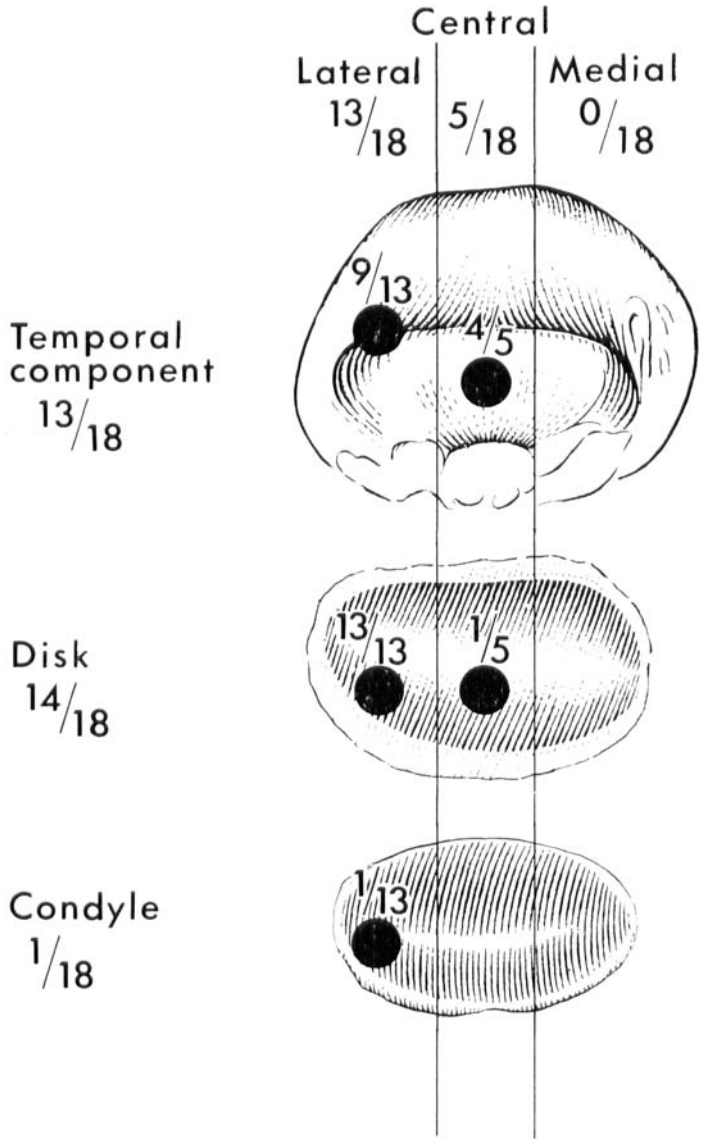

Fig. 11. Frequency of arthrotic changes in different parts of the joint and in the three articulating components in the 18 temporomandibular joints with local arthrosis.

It appears that no systematic studies of the dentition have been included in investigations of the temporomandibular joint in cadavers. *Blackwood* (1963) stressed the difficulty and the distribution of his material is by no means even regarding type of dentition (80 % complete denture warers, only 6 % with more or less complete set of teeth above 40 years). This prevented him from ascertaining whether the state of the tissues of the temporomandibular joint vary with the type of dentition.

The present material was selected according to predetermined principles and though the distribution was not even, it might nevertheless allow tentative conclusions regarding the relations between the temporomandibular joint and sex, age and type of dentition.

Sizes of joint components. Values on record are based mainly on measurements of skulls (*i.e.* void of soft tissue), but certain comparisons with the present material might be of interest. The medio-lateral diameter of the condyle has been given as 20 mm (*Lindblom* 1960; *Yale, Alison & Hauptfuehrer* 1966). This value was also found in the present material (19.8 mm). The antero-posterior diameter in our series was 9.8 mm, compared with means of 8.5 and 8.6 for the right and left condyle, respectively found by *Lindblom* (1960) in 64 dry mandibles. It is probable that the measurement of the sagittal diameter of the condyle in cadavers is influenced by persistent soft tissues more than is measurement of the transverse diameter. This may perhaps help to explain the difference between the two series in antero-posterior measurement.

The antero-posterior and medio-lateral diameters of the articular surface of the temporal component have been given by *Moffett* (1962) as, on the average, 23.3 and 23.4 mm, respectively, on the basis of 50 skulls from Shell-Mound-Indians. The breadth (m-l) thus agrees well with the mean in our material, while the length (a-p) was much larger. The mean given by Moffett is even larger than the largest value measured in our material (23.0 mm), which in view of the wide individual variation that occurred, is remarkable. One might therefore assume a true difference between the two series regarding the antero-posterior diameter of the temporal component. Whether this difference also reflects differences in temporomandibular function, cannot, of course, be decided by our investigation but surely deserves further study. The difference may also be due to measuring errors. In autopsy material the diameter of the articular surface can surely be measured with greater precision than on skull material.

The variation in size of the temporomandibular joints is remarkably wide. The size of the joint does not appear to be strongly correlated with such a parameter as body height, as judged from preliminary tables. Whether the

size of the temporomandibular joint is in any way correlated with other parameters has not yet been studied.

The superior level of attachment of the capsule on the condyle, *i.e.* the outline of articular surface, evidently varies with growth of the joint. In the youngest children the disk is tightly united with the condyle by the high attachment of the capsule so that there can be only small movements between the disk and the head. That the superior outline of the capsule is then attached to the superior surface of the condyle also medially and laterally has apparently hitherto passed unnoticed. Owing to the relatively inferior movement of the superior level of the capsule with increasing age, the normal mobility of the disk relative to the condyle is probably larger in adults, but hardly of the magnitude postulated by *Berry* (1952) and *Rees* (1954). The authors share the opinion of *Krogh-Poulsen* and *Mölhave* (1957) that the disk normally moves closely with the condyle during its translation.

The difference in inferior extension of the articular surface in children and adults may be due either to a shift in inferior direction of the attachment of the capsule with increasing age, growth of the superior parts of the head, or to a combination of these factors. The growth of the condyle probably plays the greatest role in the causation of this change. Also in the temporomandibular joint in the guineapig the attachment of the capsule is more inferior in adult than in young animals (*Öberg*, 1964).

That the upper border of the attachment of the capsule in the present material was most often situated opposite or even above the lateral poles of the condyle also in adults is remarkable, since according to textbooks, this border is widely believed to be situated inferior to the poles.

General shape of joint components. During childhood and adolescence the temporomandibular joint undergoes considerable changes in size and general shape. But also in adults remodelling may occur. The histological studies (*Moffett et al*, 1964; *Blackwood*, 1966) also suggest a considerable capacity for changes in shape of the human temporomandibular joint even in adult age. Also in animals considerable changes in general shape of the joint components have been found to occur even in high ages, *e.g.* in 3—5 year old guineapigs (*Öberg*, 1964).

Evaluation of the shape of the condyle showed good agreement with the results reported by *Yale et al* (1966); in both series there was a preponderance of the type with a medio-lateral rounded or slightly convex superior outline, shape A1 (55 and 58 %, respectively). Good agreement was found also in the appearance of the condyle as seen from above, but direct comparison in this respect is not possible because of differences in principles of evaluation.

Changes in shape and surface lesions. The local irregularities (grade 1) found most probably reflect articular remodelling. One might also imagine that they represent anatomic variants, but since they were not observed in joints from individuals below 20 years, this sounds less likely.

The lesions (grades 2 and 3) of the joint surfaces were clearly arthrotic according to conventional definitions (*Sokoloff*, 1969). At gross examination minor changes, which might histologically be defined as arthrotic, were surely missed. In the present investigation, therefore, there was probably no overdiagnosis of arthrotic changes, a source of error, which according to *Blackwood* (1963) is prone to occur in histological studies.

In what follows, articular remodelling and arthrotic changes are discussed in relation to age, sex, type of dentition and site in the joint. No correlation was found between the general shape of the joint components and arthrotic changes.

Variation with age. Local articular remodelling was not observed in ages below 20 years, but they occurred in every fourth individual between 20 and 39 years and, as far as the condyle is concerned, in about half of the joints in ages above 39 years. Arthrotic changes, on the other hand, were rare in individuals below 40 years, but relatively common (27 %) in ages above 39 years. In the same age group Blackwood (1963) found arthrosis in 40 %, but he states that in many of these cases the changes could be detected only microscopically. Blackwood has also stated that »it is doubtful whether some of the minor histological changes noted in the condyle and its articular covering are in fact, or would in fact, develop in true osteo-arthritic lesions». In our material the frequency of arthrotic changes was not higher in the oldest individuals than in those between 40 and 59 years. Factors related to age are probably important for articular remodelling and arthrosis of different joints, including the temporomandibular joint, but judging from the present results, other factors also play an important role in the development of such temporomandibular changes.

Variation with sex. The sex distribution of arthorosis in general is, according to a large American investigation (*Gordon*, 1968) fairly equal, a distribution which *Lewin* (1964) also found for lumbar synovial joints, but differences in frequency with sex evidently vary from age group to age group, with the joints studied and from series to series, (*Bauer*, 1968, *Bennett & Burch*, 1968; *Tzonchev et al.*, 1968). As in Blackwood's (1963) series, the frequency of arthrotic changes in the present material was higher in females. It is interesting to compare this unequal distribution of arthrotic changes in the temporomandibular joints with the findings in clinical studies, which always show a proponderance of females with functional

disorders of the masticatory apparatus (*Franks*, 1965; *Voss*, 1966; *Carraro et al*, 1969).

Variation with type of dentition. Differences in the tissues of the temporomandibular joint with type of dentition have been widely discussed, but few studies have been carried out on human material. We found a statistically significant difference in occurrence of changes in the temporomandibular joints with type of dentition, arthrosis of this joint being commoner in individuals with extensive loss of teeth than in those with a full set. This difference must, however, be interpreted with caution: the material is relatively small and the age- and sex distribution not ideal, so that the representativeness of the material may be questioned; the cases were grouped according to type dentition only morphologically without taking into account such functional factors as occlusal disorders, chewing habits, »parafunctions», age and quality of prosthetics etc. The age distribution, however, appears to suggest that dentitional conditions play an important role, while the uneven sex distribution appears hardly to have had any effect on the analysis (Tables I, VI and VII). Previous investigations referred to in the introduction also lend some support to the assumption that considerable loss of teeth is an important factor in the causation of temporomandibular arthrosis. In a clinical investigation *Franks* (1967) showed a correlation between extent of loss of teeth and functional disorders of the masticatory apparatus and symptoms from chewing muscles and the area of the temporomandibular joint, and stressed that it is often from the side where the teeth are lost that the joint is painful. *Boering* (1966) claimed that »a unilateral chewing habit is the most important factor in the genesis of temporomandibular joint arthrosis».

It is probable that extensive loss of teeth favours the development of such changes in the functional stress of the temporomandibular joints and that this may result in arthrosis. But other factors are surely involved, such as different forms of muscular hyperfunction and/or decreased resistance of tissues for the development of arthrosis which has been shown inter alia by the fact that several of the oldest individuals had no demonstrable arthrosis in spite the fact that they had been edentulous for many years.

The present findings suggest, however, that in the discussion of indications for partial dentures, the possible effect of loss of teeth on the tissues of the temporomandibular joint should be considered.

Development and localisation of changes in the joint. — Arthrosis is always accompanied by characteristic changes in the shape of the joints, *e.g.* peripheral remodelling of the lateral part of the condyle and progressive remodelling of the corresponding part of the temporal joint component (Fig. 8). Articular remodelling of the same appearance and site occurs also in

the absence of surface lesions (Fig. 7) and such changes were more common than arthrosis in the younger ages. These observations appear to be consistent with the assumption by *Moffett et al* (1964) and *Blackwood* (1966), that »articular remodelling of the joint usually takes place under the aegis of functional demand, but when the rate of remodelling exceeds that of orderly repair osteoarthritis may develop». It has, however, been stated that in synovial joints in general the course of development is usually the opposite so that marginal osteophyte formation (peripheral remodelling) and subcondral changes are secondary to the arthrotic changes of the joint cartilage (*Sokoloff*, 1967).

In view of the localisation of the changes it is obvious that the changes varied from one part of the joint to another according to functional load and the temporomandibular joints are surely subjected to considerable stress during function. It is also interesting to note that the fossa, which is normally probably only loaded but little during function, often shows remodelling and even arthrosis in patients with extensive loss of teeth. Judging from the observations made by *Blackwood* (1963), *Moffett et al* (1964) and by us, arthrosis of the temporomandibular joint usually first involves the disk, which is perforated, and then the articular surface of the temporal component. In local arthrosis of the posterior part of the joint, however, the disk which is thick in this area, appears to be deformed and internally deranged but not perforated, while abrasive injuries occur preferentially in the articular surface of the temporal component.

The articular surface of the condyle is damaged last and usually not at all. But, judging from *Blackwood's* (1963) investigation and our studies, remodelling of the condyle is just as common as remodelling of the temporal component. The minor histologic changes in the tissue layers subjacent to the articulating surface of the condyle, which according to i.a. *Blackwood* (1963) are common, apparently rarely develop in true arthrotic lesions.

In extensive arthrosis all joint components — also the condyle — usually show injuries on their articular surfaces. These severely changed joints (Fig. 10H—K) may perhaps be due to some systemic disease, though we tried to exclude such diseases in the collection of the material.

Clinico-roentgenological aspects. The sites of the changes in shape and surface lesions are interesting, especially from a clinical-roentgenological point of view. A roentgenologic and macroanatomic investigation of temporomandibular joints from cadavers by *Carlsson et al* (1968) has shown that advanced changes in shape of temporomandibular joints of the type seen in the 4 temporomandibular joints with extensive arthrosis can usually be seen in both the temporal component and the condyle by transcranial roentgen

projection. Local changes in the temporal component are, however, more difficult to demonstrate as well as disk perforations no matter where they are situated. Roentgenologic detection of the changes must, however, be facilitated by the observation made in the present investigation that local arthrosis is usually (in 13 of 18 cases) situated in the lateral part of the joint and that the changes in shape of the condyle readily recognised there are fairly often combined with perforation of the disk and remodelling and lesions of the articular surface of the tubercle. In certain cases such remodelling demonstrated by routine methods should therefore indicate a more comprehensive examination including roentgenographic methods as tomography and arthrography.

It is also obvious that a diagnosis of arthrosis in most cases cannot be based simply on roentgenographic demonstration of remodelling because similar remodelling may occur both in the presence and in the absence of arthrotic lesions (Figs. 7, 8). This difficulty can probably be one explanation to the frequently stressed discrepancy between clinical symptoms and roentgen findings in »osteoarthritic changes» of the temporomandibular joint (*Vestergård-Christensen* 1969). Many roentgen findings interpreted as arthrosis can probably be better described as articular remodelling, which may be asymptomatic.

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SUMMARY

Right temporomandibular joints obtained at autopsy from 115 subjects of different ages were examined macroscopically regarding the size and shape and appearance of the joint surfaces. The subjects were divided into 3 groups according to type of dentition:

I full set of teeth or practically full set, with bilateral molar support,
II reduced residual dentition, without molar support, and
III edentulous with or without complete dentures.

No subjects with known previous diseases capable of affecting joint tissues were accepted. Measurement showed that the *size of the temporomandibular joint* increased up to 20 years, especially in medio-lateral direction. The medio-lateral diameter of the condyle in adults was, on the average, twice as large as its antero-posterior diameter, 20 respectively 10 mm. The corresponding measurements for the temporal component were 23 and 19 mm, respectively.

General shape of joint components and extent of the articular surface of the condyle (the level of the attachment of the capsule on the condyle) differed, on the average, from one another in infants and adults. The individual range of variation was large.

Below 20 years all temporomandibular joints appeared »normal» but with increasing age the number of joints with local changes in the shape, remodelling, or arthrotic changes of the articular surfaces increased.

In all together 57 of 102 adult joints (56 %) articular remodelling and/or arthrotic lesions were seen. 22 joints (22 %) were judged as arthrotic changes. 31 % of the women and 16 % of the men were involved, which means an almost significant difference in frequency between sex ($p < 0.05$).

There was a statistically significant difference ($p < 0.01$) between the groups of dentition regarding arthrosis in the temporomandibular joint, suggesting that the risk of temporomandibular arthrosis is greater in persons who have lost several teeth than in those who have not.

Among the 22 arthrotic joints 4 showed extensive changes, involving all components of the joint, while 18 had local changes, 13 laterally, 5 centrally and none medially.

RÉSUMÉ

ARTICULATION TEMPORO-MANDIBULAIRE. ÉTUDE MORPHOLOGIQUE SUR MATÉRIEL HUMAIN D'AUTOPSIE

Les auteurs présentent les résultats de l'examen macroscopique d'articulations temporo-mandibulaires droites provenant de l'autopsie de 115 sujets d'âges divers. Cet examen concernait les dimensions ainsi que la forme et l'aspect des surfaces articulaires. Les sujets ont été répartis en 3 groupes suivant leur type de denture:

I denture complète ou pratiquement complète, avec support molaire bilatéral,
II denture réduite, sans support molaire,
et III édentés, avec ou sans prothèses complètes.

Les sujets dont on savait qu'ils avaient présenté une affection susceptible de provoquer des altérations des tissus articulaires ont été exclus. Les mesures ont montré que les dimensions de l'articulation temporo-mandibulaire augmentaient jusqu'à l'âge de 20 ans, particulièrement dans le sens transversal. Le diamètre transversal du condyle était chez les adultes dans l'ensemble le double du diamètre antéro-postérieur, soit respectivement 20 mm et

10 mm. Les dimensions correspondantes pour la partie temporale était respectivement de 23 mm et 19 mm.

La forme générale des parties composant l'articulation et l'étendue de la surface articulaire du condyle (le niveau de l'insertion de la capsule sur le condyle) étaient dans l'ensemble différentes les unes des autres chez les enfants et les adultes. La variation individuelle était étendue.

Au-dessous de 20 ans, toutes les articulations temporo-mandibulaires paraissaient »normales», mais, lorsque l'âge augmentait, le nombre d'articulations présentant des modifications locales de la forme, remodelage ou altération des surfaces articulaires par arthrose, allait aussi en augmentant.

En tout 57 parmi les 102 articulations adultes (56 %) présentaient un remodelage articulaire et/ou des lésions par arthrose. 22 cas (22 %) ont été considérés comme altérations par arthrose. 31 % des femmes et 16 % des hommes étaient touchés, ce qui represente presque une différence significative entre les fréquences dans les deux sexes ($p < 0{,}05$).

Il existait une différence statistiquement significative ($p < 0{,}01$) entre les groupes suivant le type de denture, ce qui semblait indiquer que les personnes ayant perdu plusieurs dents étaient plus exposées au risque de l'arthrose de l'articulation temporo-mandibulaire que celles qui n'en ont pas perdu.

Parmi les 22 articulations atteintes d'arthrose, 4 d'entre elles présentaient des altérations étendues, intéressant toutes les parties composant l'articulation, tandis que dans 18, il s'agissait seulement d'altérations locales, 13 à la partie externe, 5 centrales et aucune à la partie interne.

ZUSAMMENFASSUNG

DAS KIEFERGELENK. EINE MORPHOLOGISCHE STUDIE AN POST MORTEM MATERIAL

Die rechten Kiefergelenke von 115 Personen verschiedener Altersgruppen wurden post mortem entfernt und makroskopisch auf Form, Grösse und Oberflächenveränderungen hin untersucht. Die Fälle wurden, entsprechend ihren Bissverhältnissen, in 3 Gruppen eingeteilt:

I. Vollbezahnt oder mit nur unbedeutenden Zahnverlusten bei doppelseitiger Abstützung im Molarengebiet.

II. Reduziertes Restgebiss ohne Abstützung im Molarengebiet.

III. Zahnlos, mit oder ohne Prothesen.

Personen mit Krankheiten, die Veränderungen im Kiefergelenkapparat oder dessen direkter Umgebung hervorrufen können, wurden in diese Untersuchung nicht einbezogen.

Die vorliegenden Messungen zeigen, dass das Kiefergelenk bis zum 20. Lebensjahre vor allem in medio-lateraler Richtung, an Grössen zunimmt. Die medio-laterale Ausdehnung war beim Erwachsenen durchschnittlich doppelt so gross (20 mm.) wie die Antero-posteriore (10 mm.). Die entsprechenden Massen der Gelenkpfanne waren 23 bzw. 19 mm.

Die Form der Gelenkteile und das Niveau an dem die Kapsel inserierte, zeigten durchschnittlich grosse Verschiedenheiten zwischen Kindern und Erwachsenen, wenngleich auch grosse individuelle Variationen festgestellt werden konnten.

Bei Individuen unter dem 20. Lebensjahre wurden alle Kiefergelenke als »normal» klassifiziert, jedoch nahmen mit zunehmendem Alter Form- und Oberflächenveränderungen erheblich zu.

Mit dem Ausdruck: »Artikuläre Umgestaltung» wurden lediglich Formveränderungen bezeichnet, während mit dem Ausdruck »arthropathische Veränderung» Schäden an Gelenkflächen bezeichnet wurden.

Bei 57 von insgesammt 102 Kiefergelenken (56 %) wurde »artikuläre Umgestaltung» und/oder arthropathische Schäden konstatiert. 22 Gelenke (22 %) wurden als arthropathisch verändert klassifiziert. 31 % der Frauen und 16 % der Männer dieser Untersuchung wiesen diese Veränderungen auf, was eine fast signifikante Geschlechtsverteilung ($p < 0{,}05$) ergibt.

Statistisch sichere Unterschiede ($p < 0.01$) lagen zwischen den Gruppeneinteilungen gemäss der Gebissverhältnisse vor. Die Auswertung deutet das grössere Risiko für das Auftreten einer Kiefergelenksarthrose bei Personen mit umfassenden Zahnverlust an, ein grösseres Risiko als für Personen mit vollbezahntem Gebiss.

Innerhalb der Gruppe von 22 arthropathisch veränderten Gelenken zeigten 4 ausgedehnte, schwere Schäden die alle Gelenkskomponenten umfassten; 18 hatten lokale Veränderungen, von denen 13 lateral und 5 zentral im Gelenk lokalisiert waren. Mesial gelegene Veränderungen wurden nicht konstatiert.

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