

From: The Department of Stomatognathic  
Physiology and the Department of  
Pathology I, University of Umeå,  
Sweden.

MORPHOLOGICAL CHANGES IN THE MANDIBULAR  
JOINT DISK IN TEMPOROMANDIBULAR JOINT  
PAIN DYSFUNCTION SYNDROME

*by*

G. E. CARLSSON

T. ÖBERG

F. BERGMAN

C. M. FAJERS

INTRODUCTION

Pain in the region of the mandibular joint is a prominent symptom in the temporomandibular joint pain dysfunction syndrome (*Kruse, 1965*), but the exact cause of this pain is still obscure. It has often been postulated that though the patient refers the pain to the mandibular joint, it is usually due to neuromuscular disturbances, particularly spasm of the masticatory muscles (e.g. *Schwartz, 1955; Travell, 1960; Freese & Scheman, 1962; Wooten, 1964*). However, it has also been discussed whether and in what way pathological changes of *inter alia* inflammatory and degenerative type in the soft tissues of the mandibular joint including the disk might be a causal factor (*Boman, 1947; Sicher, 1948; Dingman & Moorman, 1951; Griffin & Barnett, 1958; Toller, 1961; Dixon, 1962; Blackwood, 1963; Davidson, 1964*).

As a contribution to the discussion of the latter theory a histological and microradiographical examination of extirpated man-

dibular joint disks from patients with pain and symptoms of dysfunction of the mandibular joint was carried out and the results are described below.

#### MATERIAL AND METHOD

The material consisted of the mandibular joint disks surgically removed from 5 patients (4 women aged 20, 24, 25 and 25 years and one man aged 22). The disks were fixed in 5 % neutral formaldehyde solution (buffered with diemal sodium). Contact micro-radiographs of the entire disk were made by the method of Öberg *et al.* (1966 a).

The disks were divided and sectioned at different levels, both sagittally and parallel to the joint surfaces. The sections (5  $\mu$ ) were stained with haematoxylin-eosin (H&E), van Gieson's stain (vG), toluidine blue (TB) and McManus's stain (PAS).

Mandibular joint disks removed *post mortem* and previously described by Öberg *et al.* (1966 b) served as controls.

*Clinical data.* All of the patients had for at least 2 years had pain in the region of one of the mandibular joints and symptoms of dysfunction of the mandibular joint, especially impaired mobility. Various conservative measures (e.g. occlusal adjustments by grinding, bite-plates and bite-guards) had failed to produce any permanent effect. The three youngest patients still had all their teeth, while the two 25-year old women had lost some of their posterior teeth but had both upper and lower partial prostheses. X-ray examination of the mandibular joints revealed only markedly reduced mobility, while arthrography suggested rupture or perforation of the disk in all the patients. At operation (Department of Orthopaedic surgery, Umeå) at which the painful mandibular joint disks were removed rupture was suspected in 2 and perforation was observed in 3.

In all 5 cases the pain disappeared after the operation, and in 4 of them the range of mobility also improved substantially. Thus, in one of the patients maximal opening of the mouth increased from about 25 mm before the operation to about 50 mm one month later.

A more detailed account of the clinical findings and of the end-results of treatment will be the subject of a future paper.

## RESULTS

*Macroscopical findings.* The excised part of the disk consisted mainly of the central portion and minor parts of the intermediate and peripheral portions (nomenclature according to Öberg *et al.*, 1966 b, Fig. 1). Of the 3 patients with perforation of the disk, one had two perforations, one lateral and one medial in the central portion (Fig. 1). In the remaining 2 the perforation was situated in the lateral part of the central portion. Around the perforation the disk was thin and its surface uneven.

*Microradiographical findings.* The microradiographs of the surgically removed disks regularly showed several radiopaque patches scattered over the entire preparation (Figs. 2 a—b). The largest opacity was about 1 mm in diameter. For comparison Fig. 2 c shows a microradiograph of a normal mandibular joint disk selected at random from the 20—30 year old group of the control disks.

*Microscopical findings.* All of the disks examined showed vascularisation in the central portion and hyaline degeneration in the connective tissue with splitting and often with deposition of fibrin. In some of the cases there were scattered islands of metaplastic cartilage and of calcifications in the tissue.

The microscopical changes are illustrated in Figs. 3—7 and a detailed description of the histological structure of one of the disks is given below.

The disk was built up of dense, collagen connective tissue. The area anterior to the perforations showed coarse fibre bundles, lying mainly in antero-posterior direction and parallel to the joint surface (Figs. 3 a—c). Posterior to the perforations the collagen bundles were arranged less regularly and the tissue was less dense than in the anterior part (Figs. 4 a—b). The upper joint surface of the disk was generally more cellular than the lower (Figs. 3 b—c; 4 b, d—e). Particularly the upper surface of the posterior part was rich in cells and contained numerous capillaries. It was most likely a continuation of the synovial membrane of the capsule. Also some areas of the anterior part of the superior joint surface were very cellular decreasing in density in anterior direction.

The deep layers especially in the posterior part of the central

portion of the disk, contained numerous relatively coarse blood vessels (Fig. 4 c) up to the middle of the anterior part (Figs. 3 d—e).

There were also numerous blood vessels near the surfaces of the disk, particularly the superior surface (Fig. 4 b).

A zone extending transversally in mediolateral direction across the disk and including the two perforations showed extensive hyaline degeneration with splitting and fibrin deposits, especially in and near the joint surfaces and around the perforations (Figs. 5 a—c). Immediately centrally to the changed parts were scattered islands of metaplastic cartilage (Figs. 5 b—c) and proliferating mesenchyma (Fig. 6 a) from the cellular part of the joint surface and in deeper layers around the vessels. In several areas detached curled collagen bundles had been forced into the joint surface (Fig. 6 b).

The radiopaque areas demonstrated by contact microradiography over the entire disk represented hyalinised mineralised connective tissue (Fig. 7 a). Further, in some cases metaplastic bone formation was demonstrated near the lower joint surface and in the actual joint surface (Figs. 7 b—c).

The homogenised and split tissue in the joint surfaces and along the edges of the perforations was strongly PAS-reactive. The areas of metaplastic cartilage showed marked toluidine blue metachromasia and PAS-reactivity in a zone immediately adjacent to the cells (Fig. 5 c).

#### DISCUSSION

Judging from published investigations of the specimens obtained *post mortem* (Macalister, 1954; Blackwood, 1963) degenerative changes in a mandibular joint disk are common and very advanced changes with necroses and calcifications have been reported (Bauer, 1932; Steinhardt, 1934). These changes have usually been described as ageing phenomena but in a histological study of operative specimens from 38 patients, most of them below 40 years, Boman (1947) found degenerative changes of various types and severity in the disk in 36, including one with co-

existing calcifications. In the present investigation of surgically removed specimens from young patients (20—25 years) with the temporomandibular joint pain dysfunction syndrome severe degenerative changes were invariably demonstrated. At any rate in these patients, then, the morphological changes observed cannot be regarded as ageing phenomena.

The investigation also showed considerable vascularisation of the normally avascular central portion of the temporomandibular joint disk, an observation previously reported by *Davidson* (1964). Moreover, metaplastic cartilage formation was noted, changes not observed in the corresponding age group in a published autopsy series (*Öberg et al.*, 1966 b). Finally, some cases with rupture and splitting of the tissue showed detached curled hyaline-sclerotic disk fragments which had been forced into the joint surfaces of the disk and which may explain the occurrence of so-called free bodies in the joint, a phenomenon hitherto described in only a few cases (*Redell*, 1959).

Microradiography showed that radiopaque patches are much more common than hitherto assumed from the results of investigations with conventional histological techniques (For survey of literature see *Öberg et al.*, 1966 a). As a rule, these densities probably corresponded to calcified hyaline-sclerotic connective tissue, but in one case they also represented islands of multiple metaplastic bone, a phenomenon which has apparently not been described before in temporomandibular joint disks.

The cause of the joint pain in patients with the so-called temporomandibular joint dysfunction syndrome is probably multifarious and various possible morphological and/or functional possibilities have been discussed. The high frequency of advanced changes in the temporomandibular joint disk in the present series, which consisted of young patients, suggests a direct causal relationship between the morphological changes and the pain, possibly owing to affection of adjacent innervated capsular tissue or to a disturbance of the physiology of the synovial membrane and the production of synovial fluid. This assumption is supported indirectly by the good results of treatment which consisted of surgical removal of the disk after unsuccessful conservative treatment.

## SUMMARY

Five temporomandibular joint disks surgically removed from young patients with a long history of pain and dysfunction of the temporomandibular joint were studied histologically and microradiographically. All of the disks examined showed extensive degenerative changes, vascularisation of the normally avascular central portion and calcifications and metaplastic cartilage and, in one case, metaplastic bone formation.

## RÉSUMÉ

ALTÉRATIONS MORPHOLOGIQUES DU MÉNISQUE DE L'ARTICULATION TEMPORO-MANDIBULAIRE DANS LE SYNDROME DOULOUREUX DE DYSFONCTION DE L'ARTICULATION TEMPORO-MANDIBULAIRE

Les auteurs ont fait une étude histologique et microradiographique sur cinq ménisques temporo-mandibulaires dont l'ablation chirurgicale avait été faite chez de jeunes patients présentant depuis longtemps des douleurs et une dysfonction de l'articulation temporo-mandibulaire. Tous les ménisques examinés présentaient des altérations dégénératives marquées, une vascularisation de la partie centrale normalement non vascularisée et des calcifications ainsi que la formation de cartilage métaplasique, et, dans un cas, d'os métaplasique.

## ZUSAMMENFASSUNG

MORPHOLOGISCHE VERÄNDERUNGEN DER GELENKSCHLEIFE (DISCUS ARTICULARIS) BEI SCHMERZEN UND FUNKTIONSTÖRUNGEN DES KIEFERGELENKES

Fünf chirurgisch entfernte Kiefergelenkschleifen, von jungen Patienten mit langwierigen Schmerz- und Dysfunktionsverhältnissen des Kiefergelenkes sind histologisch und mikroradiographisch untersucht worden. Alle untersuchten Gelenkschleifen zeigten markierte degenerative Veränderungen, Vascularisierung des normal avascularen, zentralen Teiles, Verkalkungen, metaplastische Knorpelbildung und in einem Fall metaplastische Knochenbildung.

## REFERENCES

- Bauer, W.*, 1932: Anatomische und mikroskopische Untersuchungen über das Kiefergelenk mit besonderer Berücksichtigung der Veränderungen bei Osteo-Arthritis deformans. *Zeitschr. f. Stomat.* 30: 1136, 1279.
- Blackwood, H. J. J.*, 1963: Arthritis of the mandibular joint. *Brit. Dent. J.* 115: 317.
- Boman, K.*, 1947: Temporomandibular joint arthrosis and its treatment by extirpation of the disc. *Acta Chir. Scand. suppl.* 118.
- Davidson, A. S.*, 1964: Hemodynamic theory of pain production in temporomandibular joint syndrome. *J. Oral Surg., Anesth. & Hosp. Dent. Serv.* 22: 135.
- Dingman, R. O. & W. C. Moorman*, 1951: Meniscectomy in the treatment of lesions of the temporomandibular joint. *J. Oral. Surg.* 9: 214.
- Dixon, A.*, 1962: Structure and functional significance of the intra-articular disc of the human temporomandibular joint. *Oral Surg., Oral Med., Oral Path.*, 15: 48.
- Freese, A. S. & P. Scheman*, 1962: Management of temporomandibular joint problems. C. V. Mosby Co. St. Louis.
- Griffin, C. J. & A. V. Barnett*, 1958: A preliminary report on athero-sclerosis in the temporomandibular joint and its clinical and pathological significance. *Australian Dent. J.* 3: 293.
- Kruse, I.*, 1965: Kaebe-dysfunktionssyndromet. *Odont. Tidskr.* 13: 11.
- Macalister, A. D.*, 1954: A microscopic survey of the human temporomandibular joint. *New Zealand Dental J.* 50: 161.
- Öberg, T., G. E. Carlsson, T. Ekberg & O. Hassler*, 1966: Microradiographic study of the mandibular disk in the guinea pig. *Acta Odont. Scand.* 24: 633.
- Öberg, T., G. E. Carlsson, C.-M. Fajers & F. Bergman*, 1966: Ageing of the human temporomandibular disk with special reference to the occurrence of cartilaginous cells. *Odont. Tidskr.* 74: 122.
- Redell, G.*, 1959: Om intraartikulära kroppar i käkled. *Svensk. Tandläk. Tidskr.* 52: 301.
- Schwartz, L.*, 1959: Disorders of the temporomandibular joint, W. B. Saunders Company, Philadelphia, London.
- Sicher, H.*, 1948: Some aspects of the anatomy and pathology of the temporomandibular articulation. *N.Y. State Dent. J.* 14: 451.
- Steinhardt, G.*, 1934: Untersuchungen über die Beanspruchung der Kiefergelenke und ihre geweblichen Folgen. *Deutsche Zahnheilk.* 91. Georg Thieme Verlag, Leipzig.

- Toller, P. A.*, 1961: The synovial apparatus and temporo-mandibular joint function. *Brit. Dental J.* *111*: 355.
- Travell, J.*, 1960: Temporomandibular joint pain referred from muscles of the head and neck. *J. Pros. Dent.* *10*: 745.
- Wooten, J. W.*, 1964: Diagnosis and treatment of the pain-dysfunction syndrome. *J. Pros. Dent.* *14*: 961.

## Addresses:

*Gunnar E. Carlsson*  
*School of Dentistry,*  
*University of Umeå,*  
*Umeå 6,*  
*Sweden.*

*Torsten Öberg*  
*School of Dentistry,*  
*Malmö S,*  
*Sweden*

*Frank Bergman*  
*Carl-Martin Fajers*  
*Dept. of Pathology I,*  
*University of Umeå,*  
*Umeå 6,*  
*Sweden*

III VII X XII XVI

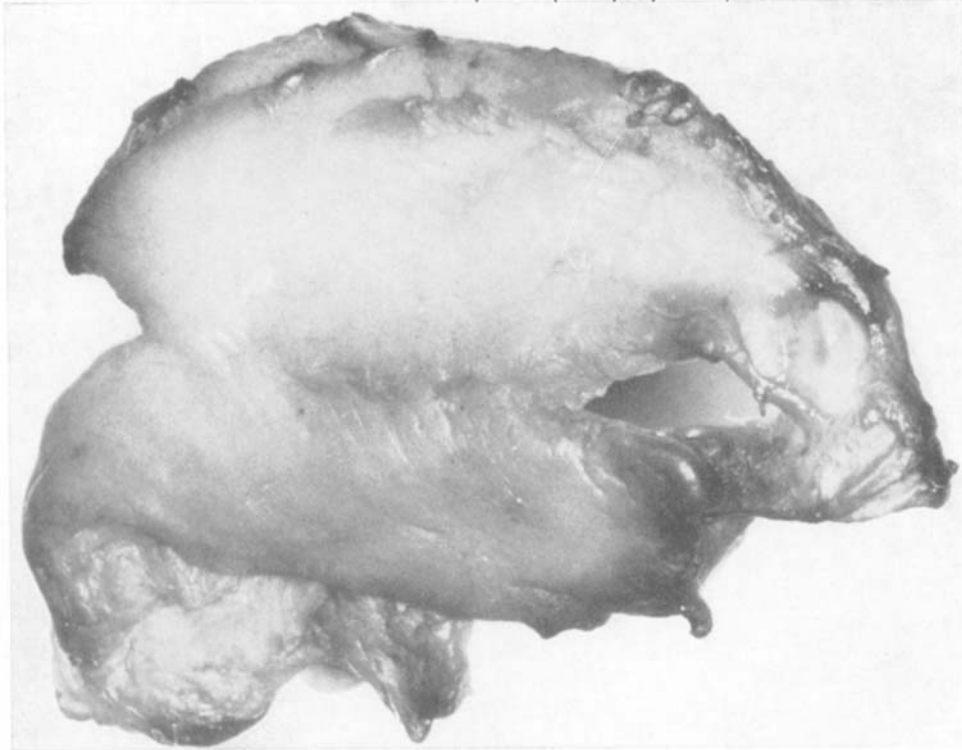
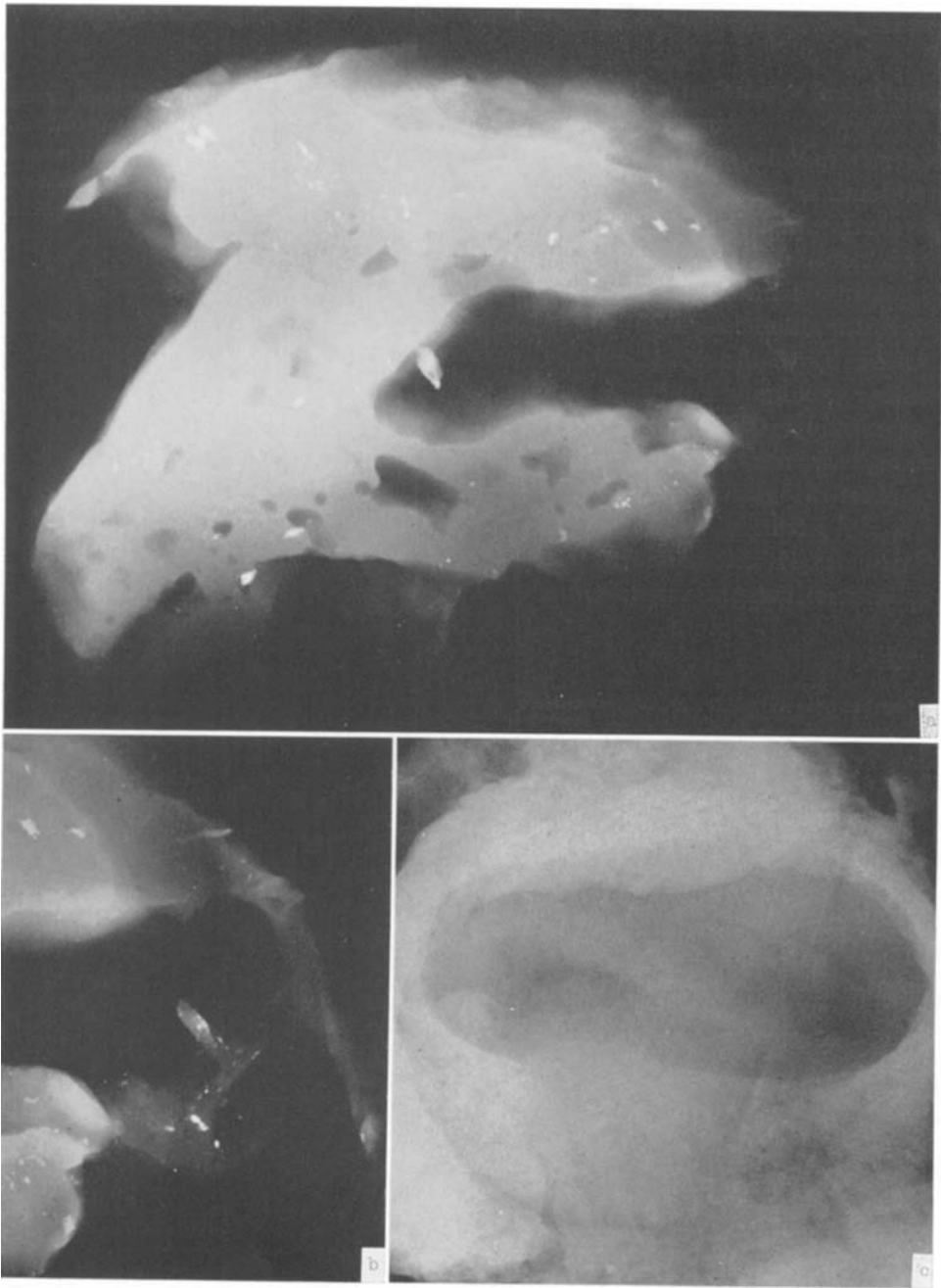


Fig. 1. The superior surface of the excised part of the temporomandibular disk from a 25-year old woman. Anterior at top, lateral to the right.  $\times 10$ . Two perforations, one in the lateral part, one in the medial edge. For microscopical examination the medial part was sectioned tangentially and the lateral part sagittally. The tangential sections were cut at 3 levels and the sagittal sections at 23 levels. The positions of 5 of the latter referred to in subsequent reproductions are indicated in the illustration (III, VII, X, XII and XVI).

- Fig. 2 a. Microradiograph of temporomandibular joint disk in Fig. 1.  $\times 10$ . Numerous densities scattered over the entire preparation.
- b. Detail of a. Distinct densities also in the lateral very thin part of the preparation.  $\times 12$ .
- c. Microradiograph of "normal" temporomandibular joint disk removed post mortem from a 25-year old subject. No densities.  $\times 5$ .

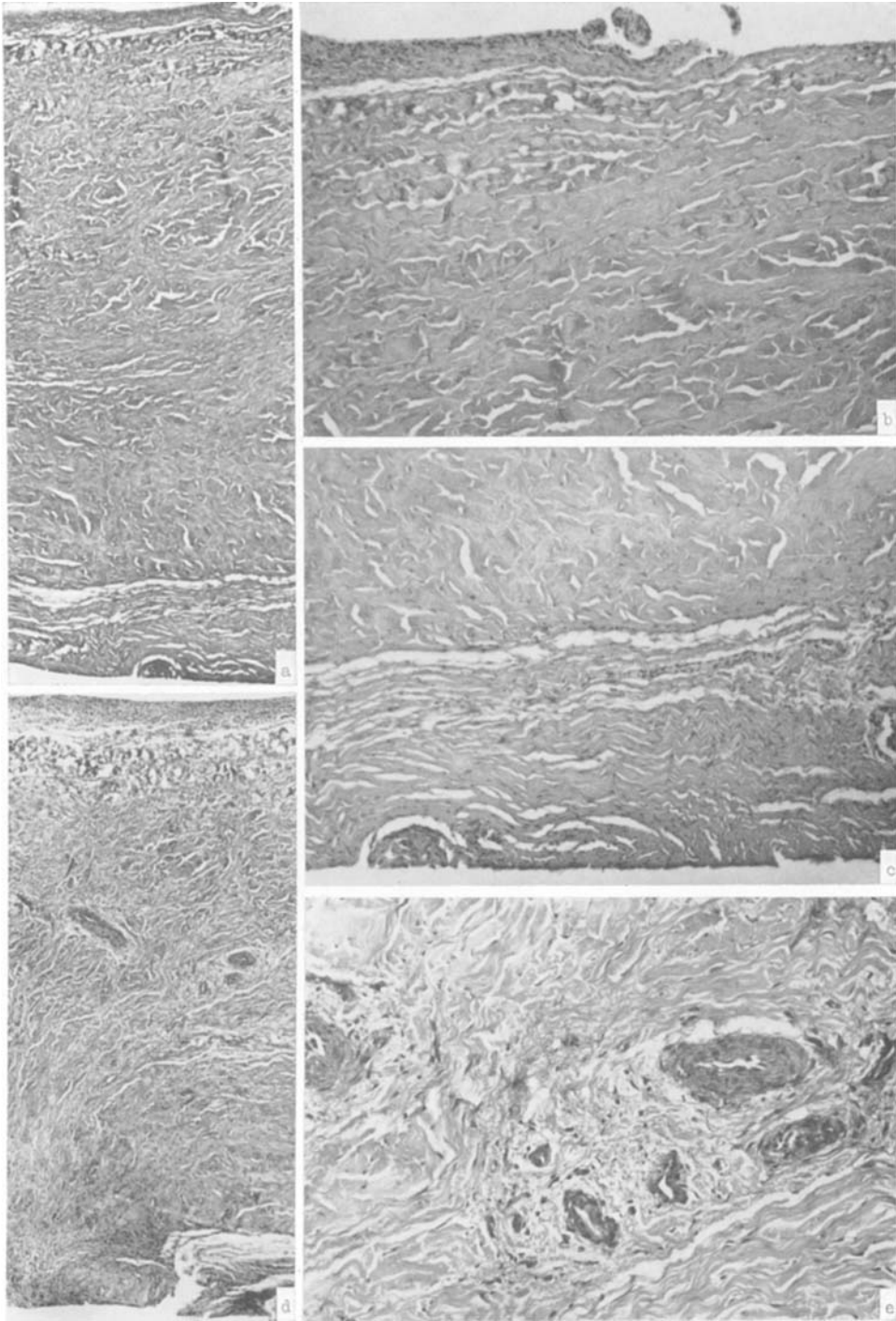


②

Fig. 3. Sagittal section of the anterior part of the temporomandibular joint disk in Fig. 1. a—c: level VII; d, e: level III.

v. G. a, d:  $\times 50$  b, c:  $\times 125$  e:  $\times 160$ .

- a. From central part. Upper joint surface uppermost in the illustration. Coarse collagen bundles arranged mainly parallel to the joint surface.
- b. Detail picture of upper joint surface.
- c. Detail picture of lower joint surface. Note vessels near the surface.
- d. Coarse vessels in the deep part of the specimen.
- e. Detail of d.

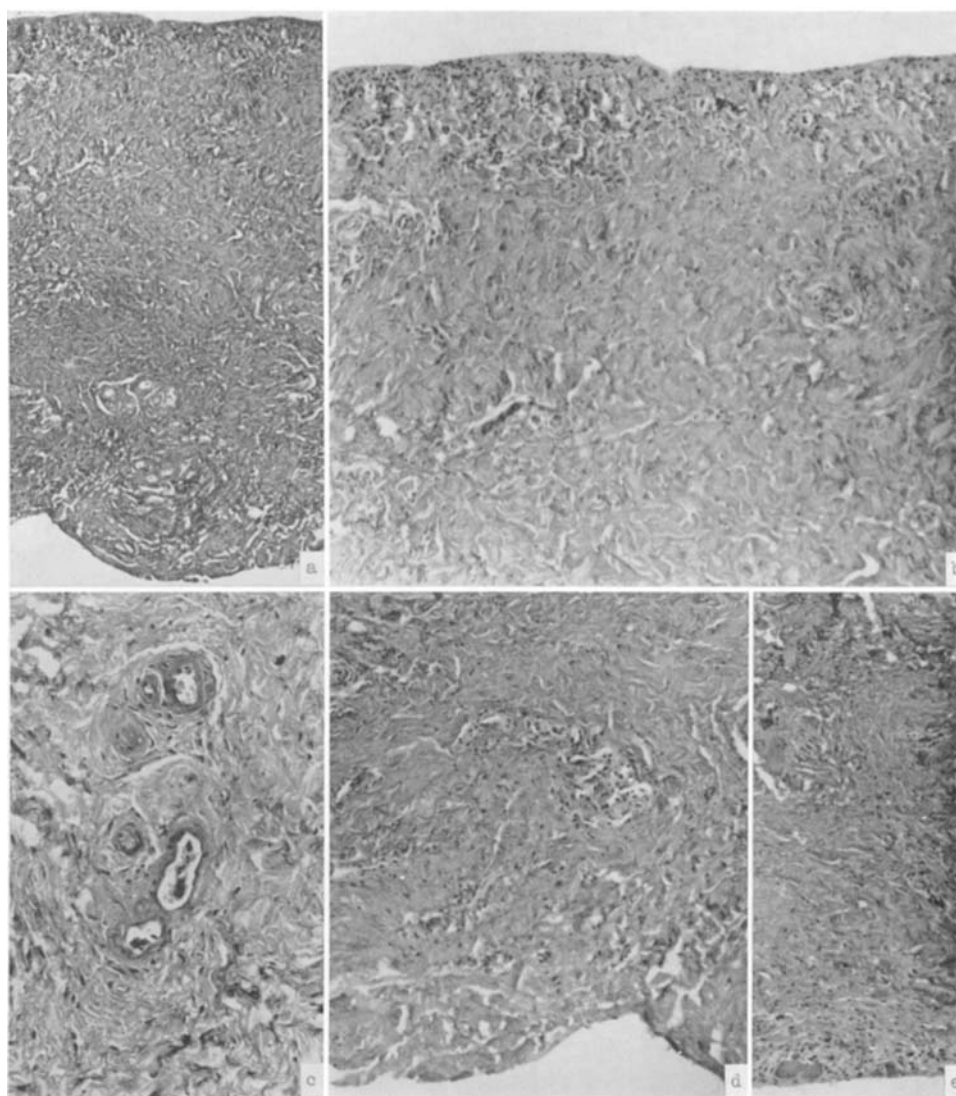


③

Fig. 4. Sagittal section of the posterior part of the temporomandibular joint disk in Fig. 1. a—d: level III, :e level VII.

v. G. a:  $\times 50$  b, d, e:  $\times 125$  c:  $\times 160$ .

- a. From the central part. Upper joint surface uppermost in illustration. Note the irregular arrangement of the collagen bundles.
- b. Detail of upper joint surface. To the left is a richly vascularized superficial layer resembling synovial membrane.
- c. Vessels in the deeper part of the disk.
- d. and e. Lower joint surface poor in cells.



④

Fig. 5. Sagittal section of lateral part of the temporomandibular disk in Fig. 1.

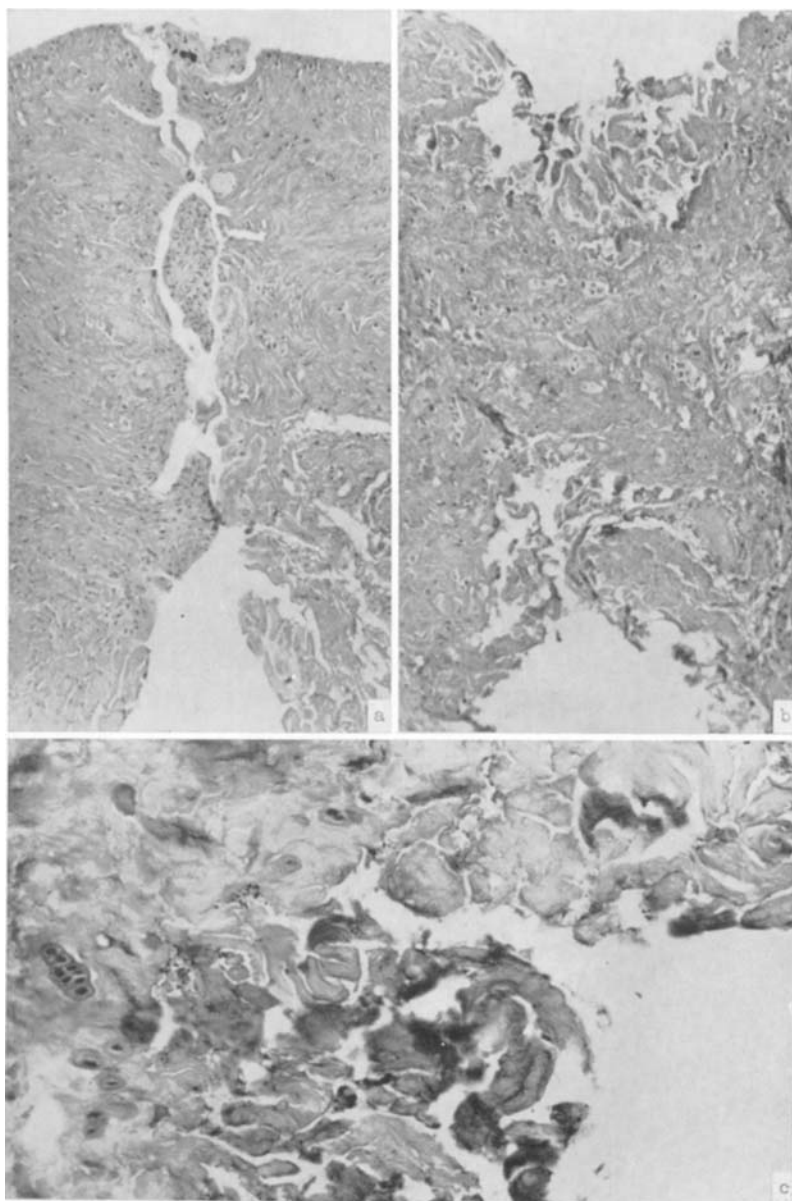
a: level III, b, c: level VII.

a, b: v.G. c: PAS.

a, b,  $\times 100$  c:  $\times 250$ .

a. Splitting with deposition of fibrin.

b and c. Severe degenerative changes with splitting around lateral perforation, and islands of metaplastic cartilage.



⑤

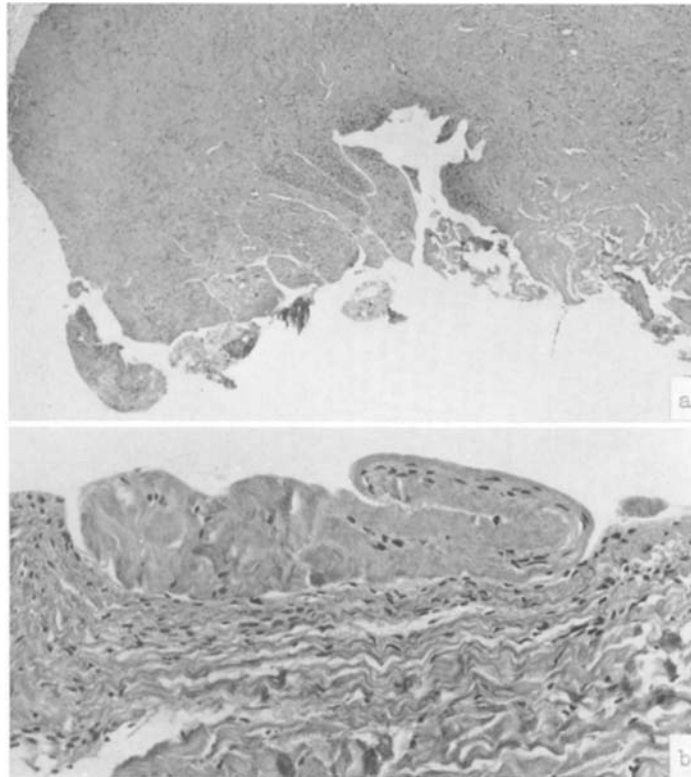


Fig. 6. Tangential section from central part (a) and sagittal section from lateral part (b) of temporomandibular disk in Fig. 1.

a, superficial level b: level X.

v. G. a:  $\times 50$  b:  $\times 190$ .

a. Antero-lateral edge of medial perforation with splitting and proliferating mesenchyma.

b. Curled collagen connective tissue forced into upper joint surface.

Fig. 7. Sagittal section of lateral part of the temporomandibular disk in Fig. 1.

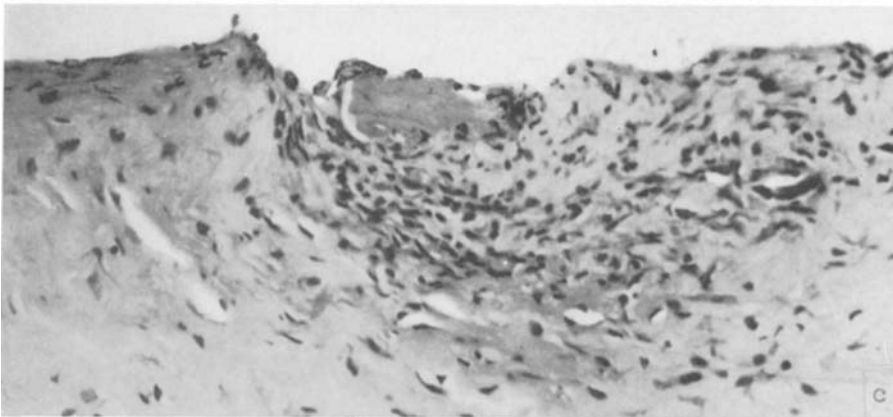
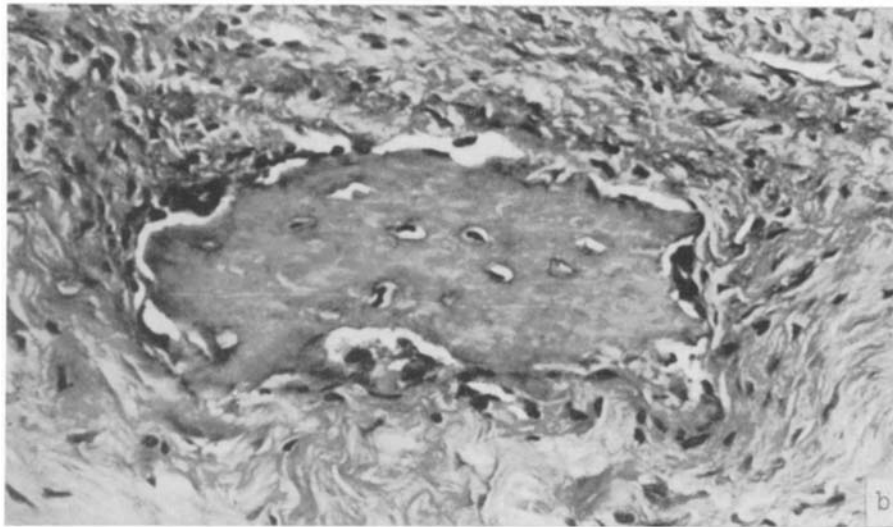
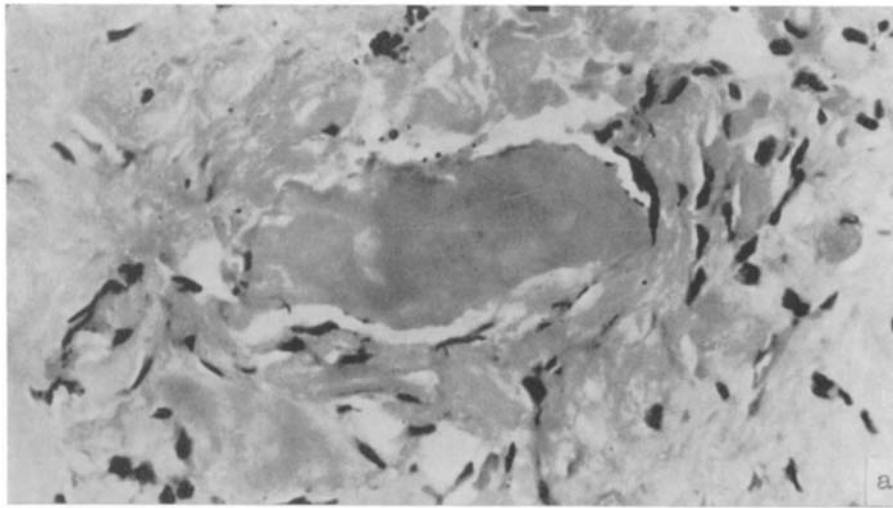
a: level XII. b: level VII. c: level XVI.

a: H & E. b: TB. c: H & E.

a—c:  $\times 190$  b:  $\times 300$ .

a. Hyaline-sclerotic, mineralised connective tissue centrally in specimen.

b—c. Metaplastic bone islands near and in the joint surface.



⑦