Arthrosis and deviation in form in the temporomandibular joint

A macroscopic study on a human autopsy material

TORE HANSSON & TORSTEN ÖBERG

Department of Stomatognathic Physiology, University of Lund, Sweden.

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The right TMJ from 115 individuals, aged 1 day – 93 years, were examined macroscopically regarding the occurrence of deviation in form and arthrosis in the three articulating joint components. The changes were classified according to extent. In addition, the depth of the arthrotic lesions was determined.

Nearly half (48 of 102) of the adult TMJs revealed some form of change. No changes in the joint surfaces were noted from individuals under 20 years of age.

Deviations in form occurred in 45 of the 48 affected joints and arthrosis in 24. The deviations in form were most common in the condyle while arthrotic lesions were noted mainly in the disk and temporal component of the joint.

The changes were usually local in nature and located in the lateral one-third of the joint.

Key-Words: Deviation in form of TMJ; Morphology; human remodelling

Tore Hansson, Department of Stomatognathic Physiology, University of Lund, School of Dentistry, Carl Gustafs väg 34, S-214 21 Malmö, Sweden

INTRODUCTION

Studies of autopsy material have shown that deviations in form (*Öberg, Carlsson & Fajers,* 1971) as well as arthroses (*Blackwood* 1963 and *Öberg et al.* 1971) commonly occur in the temporomandibular joint (TMJ). Biomechanical factors evidently play a large role in the occurrence of arthrosis as shown by *Telhag* (1973) through experimental studies on the knee joint of the rabbit. *Öber et al.* (1971) have also shown that extensive tooth loss is a predisposing factor for the occurrence of changes in shape and arthrosis in the TMJ.

The aim of the present study has been to more closely analyse the previously described autopsy material *(Öberg et al.,* 1971) concerning the occurrence of macroscopically detectable deviations in form and the presence and character of arthrosis. These findings have then been discussed in relation to the function of the TMJ.

MATERIAL AND METHOD

The material consisted of the right TMJ from 115 individuals, aged 1 day – 93 years, of

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which 102 were adults (20 years or older). The joints had been dissected and the appearance of the joint components described. The temporal component had, in all cases, been photographed from below and also, when necessary, from supplementary directions for documentation of noteworthy changes. All condyles had been photographed from above and in front and in cases where changes in form or surface lesions had been noted photographs were also taken laterally and posteriorly. As a rule the disk had been photographed both from above and from in front. Photographs had also been taken of the inferior and lateral portions when notable changes were detected.

Öberg et al. (1971) divided the present material according to the type of dentition into three main groups:

I Complete or almost complete set of teeth with bilateral molar support.

II Considerable loss of teeth, reduced dentition without molar support.

III Edentulous, with or without complete denture replacement.

The joints were evaluated concerning deviations in form and occurrence of arthrosis after examination of written descriptions, drawings and photographs taken in color and black and white.

For closer scrutiny the temporal component, condyle and disk were subdivided as shown in Fig. 1.

Deviations in form and arthrosis of the components

were classified according to extent into:

1. Local (< 1/3 of the joint surface involved).
2. Extensive (≧ 1/3 of the joint surface involved).

Arthrosis of the components was also classified according to depth into:

1. Shallow (lesion of the joint surface which was velvetlike to slightly scalloped in nature).
2. Deep (lesion which resulted in a loss of substance in the soft tissue to, or in the region of, the underlying hard structures. A «deep» arthrosis in the disk always denoted a perforation).

The localization of the deviations in form and arthrotic lesions were determined. When possible, the disk was also examined for the presence of dark-colored areas interpreted as changes in blood vessels.

RESULTS

In the ages below 20 years no signs of morphologic changes, arthrosis or discoloration of the disk were noted in the joints examined. In the remaining portion of the material the following findings were noted.

As shown in Table I, nearly half (48 of 102) of the adult TMJs revealed some form of change. Deviations in form occurred in 45 of the 48 affected joints and arthrosis in 24.

Table I. *Classification of the adult joints*

			20–39 years	40–93 years
Normal joints	53		14	39
Joints with only deviations in form	24		8	16
Joints with only arthrosis	3	48	1	2
Joints with both deviations in form and arthrosis	21		0	21
Malformed joint	1		1	0
Total joints	102		24	78

Deviations in form were most common in the condyle and arthrotic lesions in the disk and temporal component of the joint (Table II). In the group revealing only deviations in form (Fig. 2) the combination of changes in the condyle and disk was noted most often (15 joints). Deviations in form only of all three joint components were found in 10 joints. The

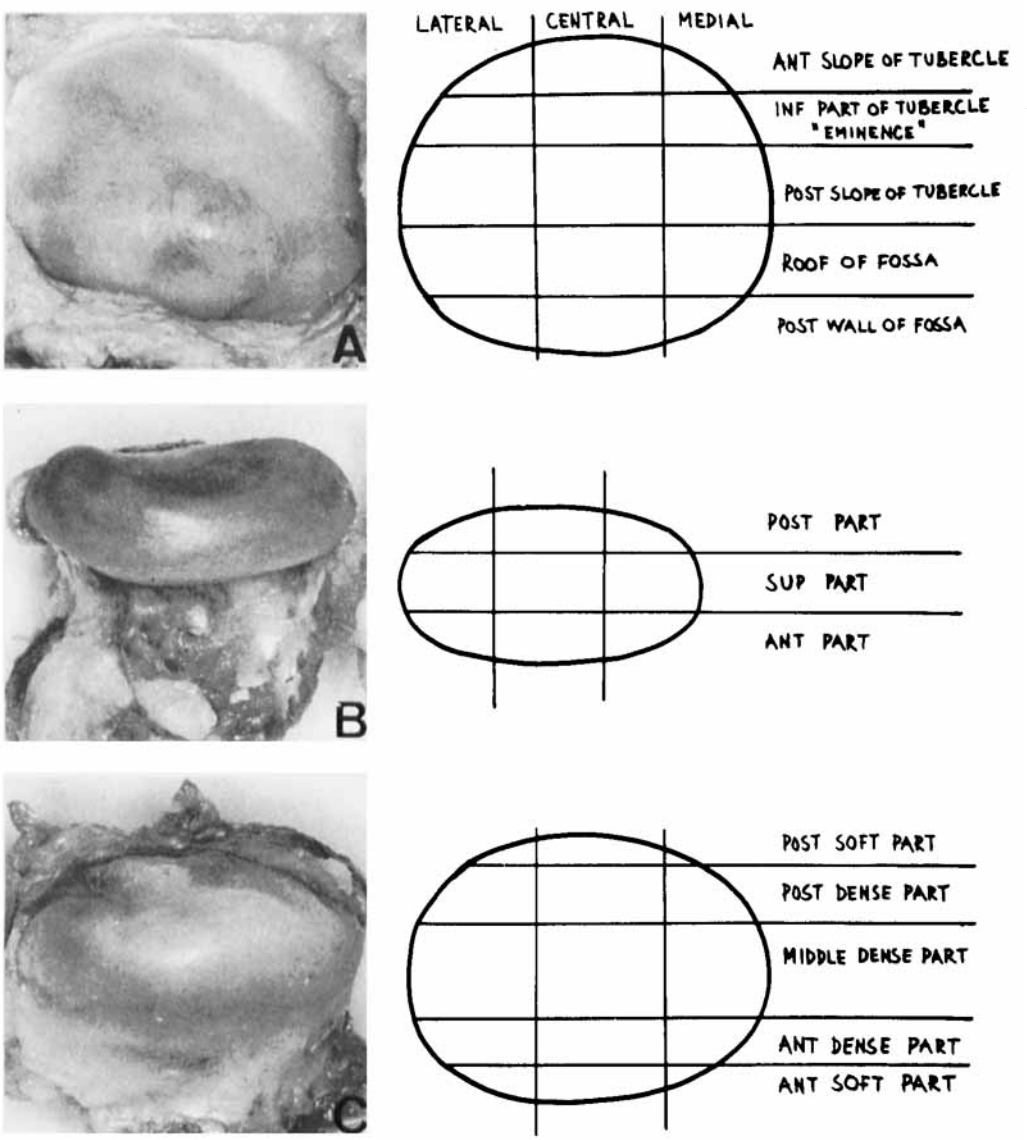


Fig. 1. Division of the articulating joint surfaces. Temporal component A (from below), condyle B (from above) and disk C (from above).

changes were predominantly local in nature as shown in Table III and located mainly in the lateral third of the joint.

In 21 joints both deviations in form and arthrotic lesions were noted. In 19 of these, morphologic changes in the condyle were combined with arthrosis in the disk, 18 of which revealed perforations. Of these 18 arthrotic disks, 13 were combined with arthrotic changes in the temporal component.

Of the total 24 arthrotic joints, 4 had extensive lesions (Fig. 3). In three the lesions were found in all three joint components and in the fourth only in the temporal component and disk.

Of the 20 arthrotic joints with lesions of a local character (Fig. 4, 5) one showed changes in all three joint components. In 10 TMJs the

Table II. *Detectable changes with respect to joint component*

Change / Joint component	Deviation in form	Arthrosis
Temporal component	27	18
Condyle	40	4
Disk	23	21

Table III. *Number of joint components with deviation in form or arthrosis only, divided according to extent of change*

grade 1 = local change
grade 2 = extensive change

Change / Joint component	Deviation in form only		Arthrosis only	
	grade 1	grade 2	grade 1	grade 2
Temporal component	18	3	10	2
Condyle	27	9	0	
Disk	19	2	16	3

Table IV. *Depth of arthrotic lesions with respect to joint component*

Depth of lesion / Joint component	Shallow	Deep
Temporal component	3	15
Condyle	0	4
Disk	1	20

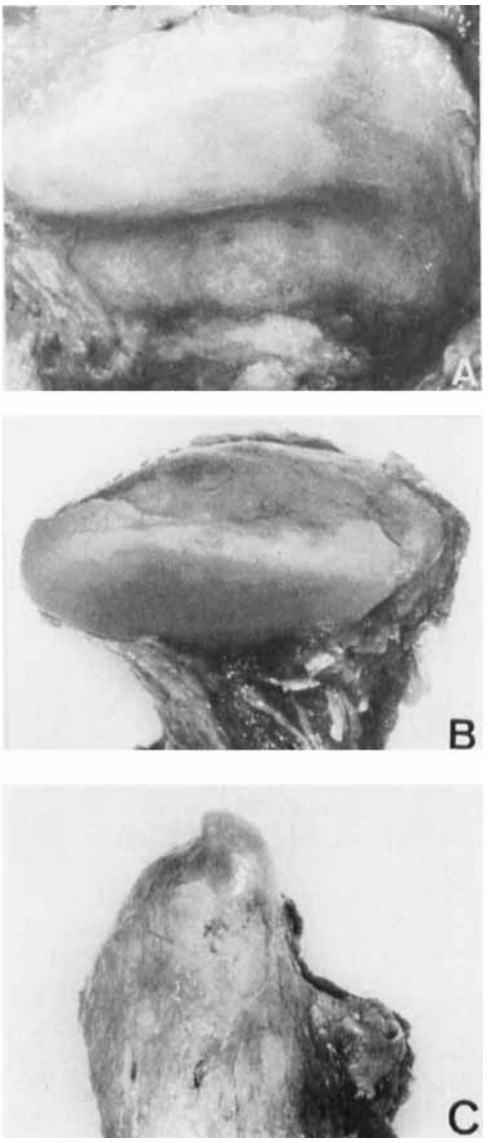
arthrotic lesions were registered in both the disk and temporal component. Six joints revealed arthrosis solely in the disk and three solely in the temporal component. The lesions were generally found in the lateral portions of the joints.

In the antero-posterior direction the lesions in the disk were most frequent in the middle dense portion and the corresponding articulatory surfaces on the posterior slope of the articular eminence and lateral wall of the fossa were also affected. From Table IV it is seen that the arthrotic lesions were mainly deep in nature. Dark-colored areas were detected in 12 TMJ disks indicating changes in the blood vessels in the posterior, lateral and central portions. These changes were divided evenly into disks with signs of arthrosis and disks with deviations in form.

DISCUSSION

During this study of the autopsy material we found two local shallow arthrotic lesions which were not noted by *Öberg et al.* (1971). These findings have later been verified by microscopic investigation. In individuals under 20 years of age all articulatory components of the TMJ revealed smooth joint surfaces, a condition necessary for disturbance-free movements in a functioning joint. A similar condition concerning form prevailed in approximately half of the adult material and was noted up to the oldest decade represented, even though remodelling in various tissue layers occurs throughout life. Hence, during favourable conditions these remodellings apparently do not result in deviations in form of such a character that they are accompanied by disturbances in joint function and TMJ clicking.

That deviations in form due to local thickenings of the articulating tissue layers can be one cause of «locking/clicking» in the TMJ is supported by a roentgenological examination of a clinical material (*Nanthaviroj et al.*, 1976). In this study, deviations in form, with or without accompanying arthrosis, were seen in 45% of the adult joints. This also lends support to the idea that deviations in form seem to be a significant factor in the etiology of TMJ clicking, since cliking was also noted in a similar frequency during recent epidemiological studies (*Helkimo*, 1974 *Hansson & Nilner*, 1975). Similar agreement prevails between the results from the above-mentioned epidemiological studies concerning the occurrence of crepitation in



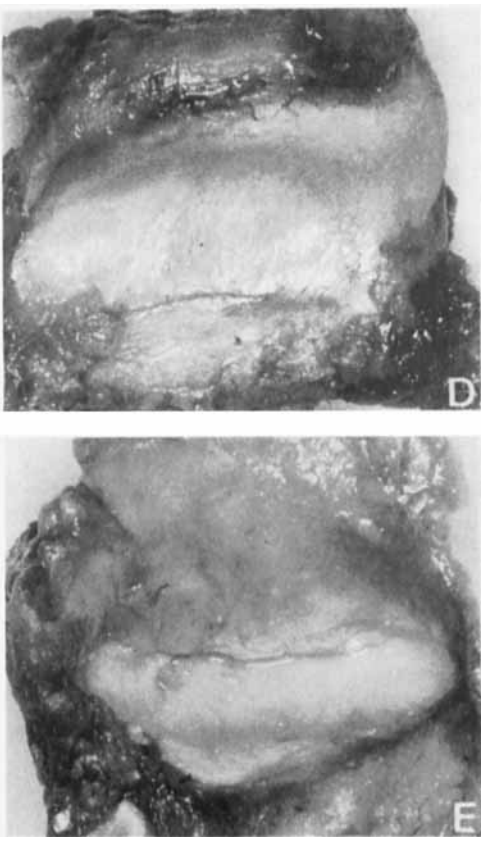


Fig. 2. A: Temporal component (from below) with elevation of the lateral and central parts of the articular tubercle.
B and C: Condyle (from above and laterally) with supero-anterior bulging corresponding to the elevation on the articular tubercle and the concavity located posteriorly on the condyle which has resulted in a medio-lateral edge superiorly.
D and E: Disk (from above and below respectively), the surfaces of which have been adapted to the shape of the condyle and temporal component. Note the groove in the inferior surface of the disk, resulting from the superior edge of the condyle.

the TMJ and the frequency of macroscopically detectable arthroses.

Since biomechanical loading is an important etiologic factor for the occurrence of deviations in form as well as arthrosis (*Öberg et al.*, 1971, *Telhag*, 1973) localization and extent of the changes reveal in both the medio-lateral as well as the antero-posterior direction the inter-componential relations during the functional loading.

Arthrotic lesions in the temporal component were most often localized laterally where they occurred predominantly in the wall of the fossa. Arthrotic lesions could not be shown in the most medial portion of the joint, either in this material or in a material from an investigation performed by *Bean, Omnell & Öberg* (1977). This finding probably results from the fact that the condyle in a medio-lateral direction has a lesser extension

than the temporal component (*Öberg et al.*, 1971), that the condyle is localized laterally in the temporal component and that the lateral pole of the condyle appeared to lie higher than the medial pole in these joints. The localization of the arthrotic lesions to the lateral wall of the fossa in combination with lesions in the juxtaposed areas of the disk would seem to result from the condyle being pressed upwards or forced laterally during function. Superior movement of the condyle can be thought to occur after the loss of premolar and molar teeth. *Öberg et al.* (1971) confirmed the connection between arthrotic lesions and loss of such teeth.

Lateral movements of the condyle can be involved through occlusal interferences or appear in the condyle on the laterotrusion (working) side during bruxism or mastication. Arthrotic lesions on the posterior and inferior portions of the articular tubercle apparently depend on wear and pressure loading on the joint components during anterior gliding of the condyle-disk in connection with opening and lateral mandibular movements during, for example, chewing and especially bruxism.

An explanation for the differences present in the three different joint components concerning the frequency of deviations in form and arthrosis would seem to be related to differences in the reactive capacity against biomechanical pressures between the three articulating joint components due to variations in histological construction. This appears to be particularly valid for the undifferentiated mesenchyme (proliferative layer) which during functional loading develops into fibrocartilage (*Öberg*, 1964, *Carlsson & Öberg*, 1974, *Hansson et al.*, 1977). In the condyle there is found, even in older individuals, more remnants of such undifferentiated mesenchyme than in the temporal component (*Hansson*, 1977). This can explain why we found such a large number of deviations in form in the condyle while arthrotic lesions, on the other hand, were markedly fewer in the condyle than in the temporal component.

Deviations in form are accompanied by an

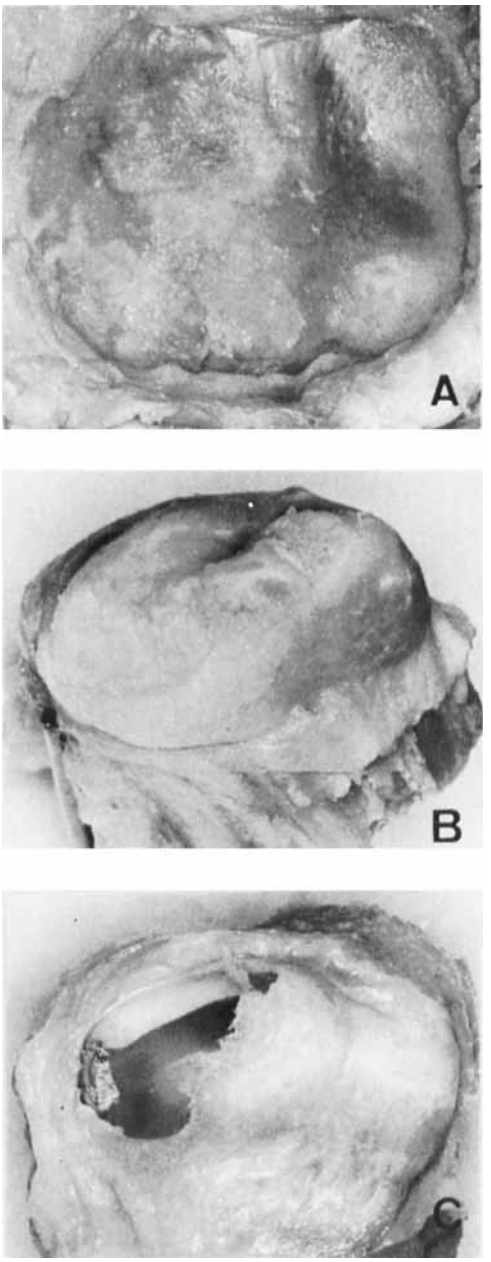


Fig. 3. Joint with extensive arthrosis.
A. Temporal component (from below) is flattened with lesions in the lateral and central portions.
B. Condyle (from above). The arthrotic lesion includes the entire superior portion with additional loss of substance laterally.
C: Disk (from above). Extensive arthrotic lesion with large lateral perforation corresponding to the deep lesions in the other two joint components.

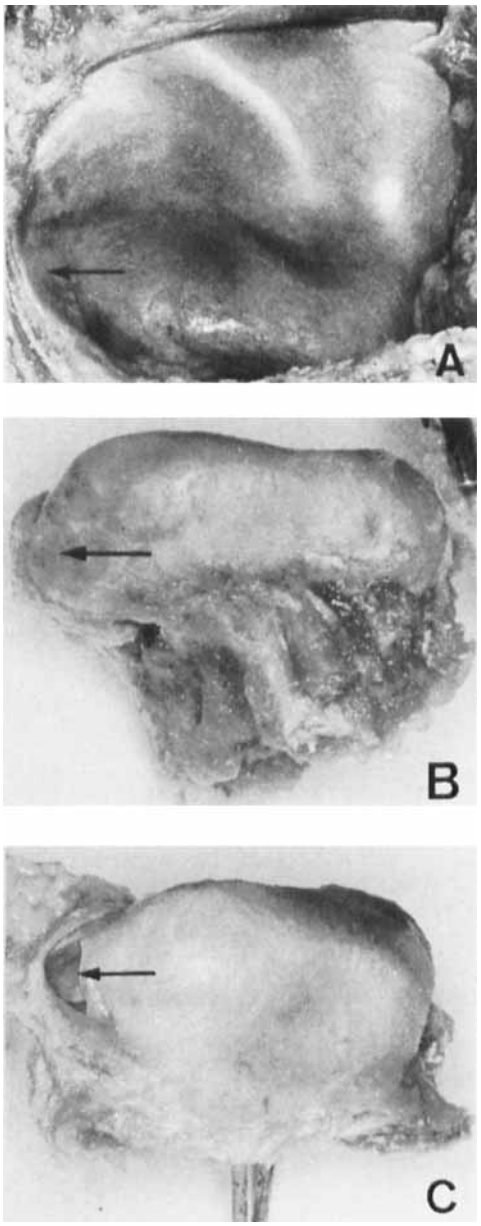


Fig. 4. Joint with local lateral arthrosis. A: Temporal component (from below) with shallow arthrosis in the lateral wall of the fossa.
B: Condyle (from above) with lateral deviation in form, elevation and flattening of the condyle corresponding to the arthrotic lesion in the lateral wall of the fossa.
C. Disk (from above). Local perforation laterally corresponding to the changes in the temporal component and the condyle.

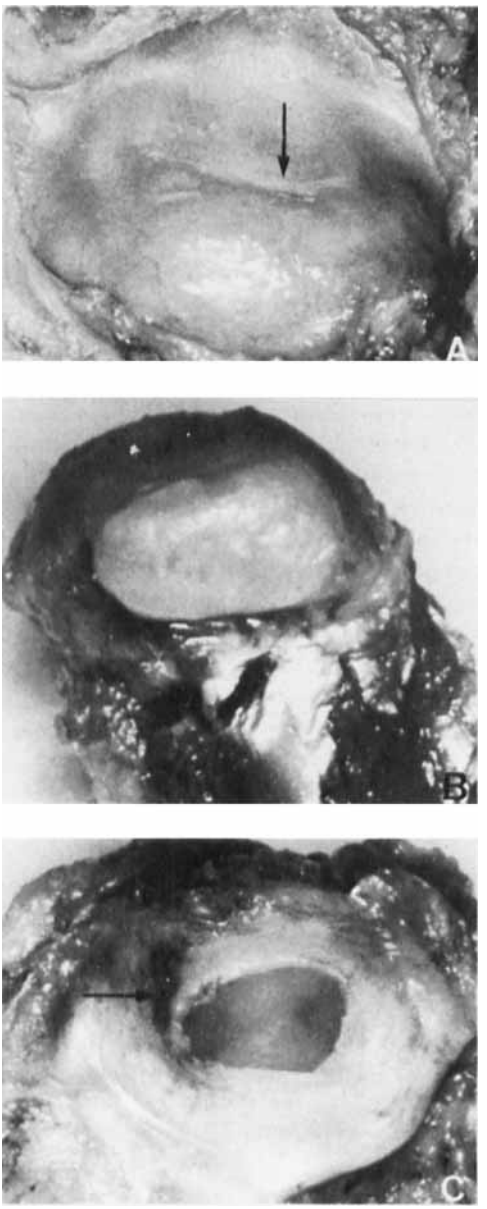


Fig. 5. Joint with local central arthrosis.
A: Temporal component (from below) with elevations and shallow arthrosis on the posterior slope of the articular tubercle.
B: Condyle (from above – in front) with marked deviation in form but intact joint surface.
C: Disk (from above) with arthrosis in the center corresponding to the marked elevation of the condyle and the arthrotic lesion on the articular tubercle during anterior gliding of the condyle-disk. Note dark-colored blood vessel invasion laterally in the normally vessel-free area of the disk.

increase in unfavourable biomechanical loading which leads to an arthrotic lesion in the joint component whose capacity to resist loading is exhausted. This is especially true concerning the disk which is lacking undifferentiated mesenchyme. Deviations in form in the disk, therefore, are dependent on form changes in the condyle and temporal component. These changes can then lead to a thinning and eventual perforation of the disk. The thin, vessel-free portion of the disk is often the first portion to be affected by arthrotic lesions and explains the high frequency of lesions seen in this component.

Another reason for the differences in the frequency of arthrotic lesions between the joint components can be that there exists a higher frictional loading between the disk and temporal component than between the disk and condyle. This is possible because the disk, as a rule, follows the translatory movements of the condyle (*Ramfjord & Blankenship*, 1971; *Öberg et al.*, 1971).

The dark-colored portions found in the posterior loose part of the disk suggest a traumatizing of these nerve- and vessel-containing areas that are not subjected to pressure loading under normal circumstances. Such a traumatizing must have great importance in the occurrence of pain symptoms from the TMJ as well as a traumatization of the attachment of the capsule laterally on the articular tubercle. Localization of deviations in form and arthrotic lesions in the above-mentioned region suggests that such a traumatization is by no means uncommon.

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