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## SURGICAL DISEASES OF THE TEMPORO-MANDIBULAR JOINT<sup>1</sup>

by

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During the past 25 years or so disorders of the temporomandibular joint have received considerable and steadily increasing attention, not the least in relation to odontological research and clinical problems. The significance of bite defects on the development of mandibular joint disorders has especially been a subject for detailed discussions, as shown by the comprehensive literature published on the question.

The question of ear symptoms arising from the temporomandibular joint followed the publication of Costen's papers in the first of which his well-known syndrome was described (1934). To this have been added various so-called "peripheral symptoms", which in the course of time have come to be thought related to suspected mandibular joint lesions.

The literature available on these subjects is so extensive and so varied in quality that it is difficult to form a proper estimate of what is actually known within these fields. Many of the papers published so far are based on rather superficial examinations of relatively small series of cases by workers with preconceived, greatly limited points of view. Others are purely speculative fantasies within fields where the authors concerned actually lack sufficient insight.

We therefore now greatly need a critical revision and a sober evaluation of this literature on the basis of larger and thoroughly examined series of cases. Attempts at this have already been made, chiefly from anatomical and physiological aspects. From a detailed study of the literature and personal experience of

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examination and treatment of about 1 000 patients with mandibular joint disorders, the author has tempted an appraisal of the development and the present state of our knowledge of the disorders of the temporomandibular joint.

A comprehensive review of the relevant literature has previously been given by *Schweitzer*, as well as *Markowitz* and *Gerry*, among others, and in Scandinavia by *Lindblom* and by *Bellinger* of the earlier period. *Staz* (1951) in an excellent paper based on a relatively large series of treated patients, concludes that further investigations are required to establish what is of clinicopathological importance. The book by *Sarnat* and his collaborators "The Temporomandibular Joint", Illinois 1951 needs special mention. In it an attempt is made to evaluate the rather vague theories previously advanced from our knowledge of the anatomy, physiology and pathology of the temporomandibular joint. We must agree with these writers in their conclusion that *there is an increasing need for a critical revision and analysis of our knowledge of the temporomandibular joint.*

Symptoms from the temporomandibular joints, such as clicking and uneven movement associated with jerky forward gliding of the condyles, occasionally accompanied by a sensation of discomfort, increasing to mild pain, are common, and do not justify us in speaking of a true mandibular joint disorder. They will often disappear after a short while.

*Foged* found such symptoms in 2 per cent of 2 400 patients admitted to hospital on account of other diseases, and *Lotsch* in 5 per cent of 230 young healthy men. *Markowitz* and *Gerry* examined 700 individuals and found symptoms from the temporomandibular joint in no less than 20 per cent, of whom only a quarter were so troubled that they sought treatment. In agreement with this observation *Boman* found that 40 per cent of the subjects examined who had previously had symptoms from the temporomandibular joints were completely free from symptoms at the time of examination. *Ireland* points out that some cases with even pronounced symptoms recover spontaneously within a few weeks.

It is also the author's experience that by questioning a large number of people with no spontaneous complaints a history of the so-called "abnormalities" of the temporomandibular joints

can be elicited from the majority, and even more often a history will be obtained of previous transitory symptoms in individuals who on examination present no signs or symptoms of mandibular joint disorders.

*The anatomy of the temporomandibular joint* is rather complex, and large muscle groups are involved in the function of the joint. Its physiology is further characterized by the functional relationship between the two joints on the one hand and the occlusion and articulation of the teeth on the other. Analyses of cadaver dissections, such as those of *Bauer*, are therefore unlikely to throw light on the dysfunction possibly underlying the mandibular joint symptoms. *Hjortsjö* from comprehensive anatomical studies of the function of the mandibular articulation has pointed out that a detailed analysis of the functional play of the *mandibular joint muscles* is required. The neuromuscular balance between the various muscle groups concerned with movements of the joint should be studied by modern methods, as attempted e.g. by *Carlsöö*. Very recently *Sicher* published his results of investigations on which he based the view that the local and regional symptoms from the temporomandibular joint may be due to compression of the loose, vascular connective tissue containing nerves between the posterior edge of the disk and the joint capsule, whereas the extra-articular pains as a rule are of muscular origin. Pain from the temporal muscle is felt in the ear and the temple, from the masseter in the cheek, from the external and internal pterygoid muscles in the pharynx, and from the geniohyoid and digastric muscles in the tongue. The most frequent causes of the muscular dysfunctions are said to be bite defects and nervous factors ("emotional tension").

#### SYMPTOMS

A great number of symptoms have gradually come to be associated with mandibular joint lesions. Thus, in addition to true articular symptoms they include especially ear complaints and indefinable pain in the oral cavity, head and neck.

*The true articular symptoms* comprise pain and tenderness, clicking or grating, and abnormal mobility.

*Pain* localized in the joint and adjacent regions frequently

dominates the picture and first makes the patient seek medical advice. It is most often provoked by movements, forced opening or overclosure, but spontaneous pain is by no means rare. The pain may be associated with tenderness of the joint to palpation in front of the ear, or more often through the external auditory meatus against the dorsal surface of the joint.

*Clicking* in the joint on movement is a very common symptom, sometimes alone and sometimes in association with other symptoms, especially pain. It may occur as single loud clicks or as a more prolonged grating during any phase of a movement, particularly, however, towards the final stage of opening, as a so-called terminal click. Clicking alone relatively often occurs as a transitory symptom, which disappears spontaneously after varying periods. In such cases no comprehensive examination or treatment are indicated; but the clicking may occasionally be so pronounced that the noise, especially during meals, is rather trying, not only to the patient but also to others.

In mandibular joint disorders movements may be restricted in both the vertical and the horizontal planes. The opening movement may be reduced to practically *nil*; and it is characteristic that the midline of the mandible on opening deviates towards the affected side. At the same time horizontal movement towards the normal side is limited or abolished. This feature serves to differentiate this form of trismus from that due to extra-articular causes.

A characteristic "locking" of the mandible is a not infrequent symptom accompanied by pain. The fixation is "unlocked" more or less suddenly with an audible click by manipulation of the jaw. The symptom is probably in some cases due to subluxation, where the condyle has difficulty in gliding back to its normal position, and in others to definite jamming of a pathological disk (*Schultz*).

*The regional symptoms* have been a subject of much discussion. In 1934 *Costen* advanced his well-known theory of a syndrome consisting of auditory and other regional symptoms in consequence of lesions of the temporomandibular joint. He regarded this syndrome as a common phenomenon and considered the symptoms to be "reflex neuralgiae" due to mechanical irritation of the joint, due in turn to an unphysiological position

of the condyle. Many clinicians have since extended Costen's theory frequently on very slender evidence to include numerous complaints even when these are localized rather far from the mandibular joint.

*Monson*, as early as in 1920, regarded auditory symptoms, in the first instance deafness, as caused by compression of the external auditory meatus owing to eccentric position of the condyle in the joint. As late as in 1947 *Goodfriend*, among others, adhered to this theory, even to the extent of believing that 40 per cent of all deafness is due to mandibular joint disorders. Other writers, who have based their investigations on larger series of cases, e.g. *Ireland* and *Hankey*, have rarely found ear symptoms in association with mandibular joint diseases. *Lindblom*, in a fairly large and thoroughly examined series, found impaired hearing in no more than seven patients (about 12 per cent), and in six of these otological changes were present to account for the impaired hearing. Thus, in only one case could the impaired hearing possibly be considered to be due to the joint affection. *Myrhaug's* hypothesis that ear symptoms in patients with definite pathological changes in the ears can be related to a "functional" mandibular joint disorder, of which no signs are demonstrable except a deficient dentition, must be rejected as quite unreasonable.

*Thonner* (1953), in a comprehensive work, discusses the previously published attempts to explain the occurrence of auditory symptoms in association with mandibular arthrosis. *Thonner* states that the results achieved with his own series of cases, of which no detailed account is given, however, are in favour of a relationship between mandibular joint disorders and auditory symptoms. He describes an anastomosis not previously known from the internal maxillary artery to the inner ear (internal auditory artery), which passes through fissures in the glenoid fossa, and which presumably may be injured by the condyle.

*Dechaume*, *Paggioli* and *Rouot* also in 1953, advanced the theory that distant symptoms in cases of malocclusion are due to the rich sympathetic innervation round the carotid branches and the temporomandibular joint. Accordingly, they employ periarterial infiltration with novocain in addition to bite correction. It is, however, as yet impossible to assess their results.

The weightiest contributions to the discussions in recent years in this field have been made by *Sicher* and *Zimmermann*.

*Zimmermann*, in Sarnat's book previously mentioned, evaluates Costen's syndrome from an anatomical point of view. He is very critical of the syndrome as such, and is of the opinion that only one group of Costen's symptoms rests on an acceptable anatomical basis, namely that of pains in the trigeminal and occipital regions, so-called referred pains.

*Sicher* (1948) is also strongly opposed to the commonly advanced theories that the radiating pain and other regional symptoms are due to pressure of the condyle on the chorda tympani, the auriculotemporal nerve, and the Eustachean tube associated with a lowered bite. He says that these theories are based on a deficient knowledge of the anatomy of the region concerned.

*Sicher* (1955), in a recently published paper, emphasizes, as already mentioned, that regional pains may be reflex pains provoked by compression of the joint, but that extra-articular symptoms are most often of muscular origin.

In recent years the significance of muscular dysfunctions has played a prominent part in discussions on the relationship of regional and more distant symptoms to mandibular joint disorders (e.g. *Aasgaard*, *Copland*, *Schwartz*, as well as *Berlin*, *Dessner* and *Åberg*).

In this connection it is worth pointing out that restricted movement of the mandible, need not necessarily be caused by an articular lesion. *Extra-articular constriction* (trismus) is not uncommon and may have many different causes. Tetany (*Jacobs*) and strychnine poisoning are examples of general diseases associated with marked trismus, which may simulate total ankylosis. Hysterical trismus is another condition to be borne in mind (*Thoma*).

Affections of the *masticatory muscles*, such as infiltrations and myalgia, are now, as just stated, to an increasing extent regarded as the cause of symptoms localized in the area of the temporomandibular joint. Some of these cases are presumably due to bite displacement; but the majority are probably due to purely muscular dysfunctions and bad masticatory habits, bearing no aetiological or pathogenetic relation to the joint as such. Local, regional, or general muscular dysfunctions due to emotional causes

must also be considered to be rather frequent; but it seems unreasonable to include such cases under "mandibular joint disorders", and local treatment of possible bite defects should at any rate be regarded as no more than a supplementary detail.

Various reports are available on gross anatomical changes, fibrous or osseous, of the masticatory muscles as the cause of "extra-articular ankylosis" (*Nizel and Prigge, Kostrubola and Talbot, Anderson and Smith, Beck*).

Finally, it should be mentioned that fibrous or osseous adhesion of the *coronoid process* to the zygomatic arch may be the cause of limited mobility or complete immobility of the mandible following fractures in this region (*Brown and Peterson, Beiter and Waggoner*).

#### X-RAY EXAMINATION

plays the same important part in examination of the temporomandibular joint as in other joints and bones, even if we admit that several mandibular joint disorders with pronounced clinical symptoms show no radiographic abnormality. This is particularly true of many of the so-called arthroses.

X-ray examination is, however, technically difficult, and it requires great experience to assess the pictures. Much of the confusion prevailing about lesions of the temporomandibular joint is doubtless due to the fact that inexperienced investigators have quite uncritically drawn far reaching conclusions from X-ray films of doubtful quality. Routine X-ray examination of the joint without special technique and without radiographic-odontologic experience is of little value and often misleading rather than informative.

The difficulties have long been recognized, and various attempts have been made to meet them by employing a technique allowing comparison of the two joints of the same individual as well of the joints of different individuals and at different times. In addition to the usual assessment of the film with regard to the contours and structures of the joint and bones, it has especially been thought possible to draw conclusions from the position of the condyle in the joint cavity at rest and on occlusion. Especially, great importance has been attached — definitely without sufficient evidence — to a deep and eccentric position

of the condyle in the glenoid fossa in association with quite trivial bite defects.

*Lindblom*, among others, in his detailed studies on mandibular joint disorders, lays stress on X-ray examination, but also points out some of its shortcomings. However, when employing a technique devised by himself, he feels justified in attaching decisive importance to the X-ray examination, more particularly to its disclosure of the position of the condyle in the joint cavity.

The most detailed and best description of X-ray examination of the temporomandibular joint has been given by *Nørgaard* in a monograph, in which he also presents the results of comprehensive studies on arthrography of the joint. *Nørgaard* claims to have achieved good results with arthrography. Little use has, however, been made in practice of this method of examination, presumably because it is technically difficult and the pictures are difficult to interpret. It is therefore applicable only in special departments dealing with a considerable number of cases of this kind and because it is rather inconvenient to the patient, it should be reserved for special purposes.

Recent years have seen weighty arguments against the uncritical evaluation of routine radiography of the temporomandibular joint. *Warren Harvey*, as early as in 1948, emphasized that we are not justified in instituting a treatment of a mandibular joint disorder on the basis of X-ray examination alone, unless this reveals gross abnormalities.

In 1951 *Brodie* pointed out the uncertainty in assessing X-ray films taken by the usual technique, which, in his opinion, are of little value. *Brodie* mentions "Lindblom's technique" and tomography as the most reliable methods, whereas arthrography is not discussed. *Reboul*, *Duhamel* and *Harribey* likewise mention *tomography*.

Attention is drawn to some investigations in recent years by *Schreiber* and by *Amer*. They strongly deprecate the previous, often ill-considered use of X-ray examination. *Schreiber* submitted skulls to X-ray examination from different views and found that the position of the condyle in the joint cavity cannot be judged from the X-ray films. Add to this the great normal variation, pointed out by *Amer*, not only from one individual to another, but also between the opposite sides of the same indi-

vidual, it is evident that X-ray films of the temporomandibular joint should be assessed with great caution. *The previously alleged usefulness of X-ray films to determine the supposed influence of bite displacements on the position of the condyle in the glenoid fossa, and consequently on the production of mandibular joint symptoms, is presumably entirely without foundation.* Similarly, an estimate of the effect of a bite-correcting treatment based on X-ray examination of the joint must be regarded as worthless.

#### DEFORMITIES

Intra-articular deformities of the temporomandibular joint are rare. Most important is the unilateral *hyperplasia of the condyle*, which gives a characteristic picture with pronounced signs and symptoms, and which is therefore relatively often referred for treatment. The deformity was described as early as in 1836 by Adams (quoted by Gottlieb). In 1856 Humphrey performed the first condylectomy for this condition. Various cases have been described in recent years, Rushton 1946 and 1951, but the largest series collected by one writer was reported by Gottlieb. His report is based on examination and treatment of 12 cases. In addition, he gives a fairly detailed account of previous papers. The number of cases seen in this department has since increased to more than 25.

The most prominent sign is the characteristic facial disproportion with deviation of the mandible and corresponding malocclusion. In advanced cases the maxilla is nearly always considerably deformed, presumably a secondary phenomenon of adaptation. Pain in the deformed joint is a common symptom, though not invariably present.

The aetiology is unknown. In several cases (in Gottlieb's report about half) the deformity seems to be due to tumour-like processes, osteomas. Operation is the only effective treatment and is most often indicated from aesthetic as well as functional reasons. Condylectomy is generally necessary. However, in cases with moderate deformity and with no tumour-like processes satisfactory correction may possibly be obtained by osteotomy of the ramus.

The results are good, but can often be further improved by orthodontic treatment.

Similar deformities due to tumour formation in the temporomandibular joint have lately been described by *Worman*, *Waldron* and *Radusch* as well as *Gabka* and *Thoma*.

*Congenital dislocation* of the temporomandibular joint has been described by *Gingrass* in a 47-year-old patient with a completely undeveloped glenoid fossa. In addition, the patient presented pronounced hypoplasia of the homolateral half of the mandible, as seen in cases of unilateral ankylosis.

#### TRAUMATIC LESIONS OF THE MANDIBULAR JOINT

These are very common. They comprise the usual gross, acute traumatic lesions, in contradistinction to those mentioned elsewhere, for which milder prolonged traumatic actions may be responsible, i.e. undue stress, due primarily to bite displacement.

Simple *contusions*, possibly associated with haemarthrosis, do occur, but the intra-articular fractures and dislocations are the main lesions.

##### *Intra-articular fractures*

These are usually located high in the neck of the condyle; more rarely the condylar head is fractured. The neck fractures may occur alone or typically in combination with fracture of the contralateral body. There is usually backward displacement of the mandible on the injured side and deviation of the midline towards the latter. Pain and especially tenderness anterior to the ear are very characteristic symptoms. The external auditory meatus may be injured with haemorrhage from the ear as a result. A common and important complication is simultaneous dislocation of the mandibular joint, most often with the condyle displaced medially and possibly anteriorly.

Prompt reduction and fixation in normal occlusion by intermaxillary fixation is an excellent treatment, which gives good results in nearly all cases, including those with dislocation fractures. For the sake of the mobility the fixation should not be retained too long. Unless the treatment of other concurrent fractures necessitates prolonged fixation, the fixation should be

slackened and made elastic to allow some movement after two weeks. The intermaxillary fixation can often be replaced by a splint, which on occlusion forces the mandible into the normal position. In cases of isolated fractures of the condyle, especially when associated with dislocation, such treatment, which allows a certain movement from the beginning, is very suitable.

This "conservative" treatment is recommended by practically all writers whose works are based on wide personal experience. *Chalmer J. Lyons Club*, on the basis of a follow-up of 120 patients, concludes that operation with open reduction and direct bone suture rarely is indicated. *Salman* states that intermaxillary fixation gives favourable results in nearly all cases. *MacLennan* followed up 120 out of 180 cases and concluded that early restoration of normal occlusion is of primary importance. The fixation must not last too long. Surgical treatment, pin fixation or operative reduction and suture are not indicated. *Dechaume* and *Crepy* hold that intermaxillary fixation gives good results, but find prolonged observation necessary. Active surgical intervention is hardly ever required, except occasionally when the conservative methods have failed. Even anatomically poor results cause little inconvenience. *Gerry* is also of the opinion that surgical reduction is rarely indicated, because intermaxillary fixation as a rule gives good results also in cases with concurrent dislocation. If it does not, he raises the question whether condylectomy is not preferable to attempts at reduction. *MacGregor* also advocates conservative treatment.

However, surgical treatment has its adherents, especially in cases of dislocation fractures. *Henny* states that excellent results are generally achieved with conservative treatment, but he indicates a surgical method for operative reduction and suture, which he has employed in 24 cases. Follow-up examinations allowing of an evaluation of the results are not available, however. *Richardson* and *Cohen* strongly advocate operative treatment of fractures of the condylar neck, but they do not report an adequate number of cases to support their view. They confine themselves to describing two cases without follow-up. *Stuteville* has attempted operation in a few cases. He states that reduction and suture are easy to carry out and that the primary results are good, but the patients have not been followed up.

*Thoma* strongly recommends surgical reduction and direct bone suture in fractures of the condylar neck with associated displacement, especially in cases with concurrent dislocation. However, he has not described any cases thus treated to justify his contention.

The author's personal opinion, based on the treatment of more than 200 cases of condylar neck fractures, of which a considerable proportion had associated displacement, is that conservative treatment nearly always gives excellent results, with normal or almost normal function also in cases with concurrent dislocation, and where reduction of displacement at the site of fracture or in the joint is not obtained. Primary surgical treatment is therefore never indicated. In the few instances of persistent pain or restricted movement, and possibly ankylosis, operation was performed for removal of the condylar fragment. Early condylectomy has been done in rare cases only, where the position of the condyle prevented reduction.

Various writers have stated that especially fairly young children should be submitted to operation with reduction to avoid secondary disturbances in the region. In the author's view this is fallacious. The disturbances of growth are not caused by the impaired or altered function, but are a direct consequence of the action of the injury on the growth zone, which will probably be further damaged by surgical intervention.

#### *Dislocation of the temporomandibular joint*

True dislocation of the temporomandibular joint may be the result of a violent strain, not infrequently by forced opening of the mouth during dental treatment. The symptoms are usually rather alarming and characteristic, the diagnosis being therefore easy to make. The treatment is that of reduction as soon as possible, which as a rule causes no great difficulty. Occasionally, however, anaesthesia is required to obtain sufficient relaxation of the masticatory muscles. Very rarely will surgical replacement through arthrotomy be necessary.

Following reduction the joint should be spared as much as possible for one or two weeks, but fixation with external bandaging or intermaxillary fixation is rarely necessary.

*Unreduced dislocation* is far more difficult to treat. If the dislocation is overlooked at first and the patient does not seek treatment till later, muscular contractions or cicatricial changes in the joint may make reduction extremely difficult, and often even impossible. The patient generally seeks medical advice on account of restricted movement or deformity due to the abnormal position of the jaw (facial disproportion, apparent mandibular protrusion), rendering prosthetic treatment, for instance, difficult. In such cases operation is usually indicated.

*Basil Jones* reports a case of dislocation in a patient, aged 16, which occurred 9 years previously during tonsilectomy. Osteotomy of the ramus was done by the Kostecka method with a favourable result. The same treatment was given to a patient described by *Harpman*, a 16-year-old boy with bilateral dislocation of 11 years' standing. The immediate result was good, but the deformity recurred after about 2 years.

*Gottlieb* reports three cases of unreduced dislocation, of which two were bilateral. Attempts at reduction and prolonged traction failed. Resection of the condyles was performed, as during the operations it was seen that proper reduction to the fibrously obliterated joint cavities would be impossible. The results were good.

*Wang-Norderud* has treated a case by condylectomy followed by alloplasty. The immediate result was good.

*Recurrent dislocation* is very troublesome. Several methods of operation differing in principle have been suggested. In 1953 *Foged*, in connection with a report on 12 own cases, gave a good survey of the problem. He has personally operated on five patients by *Konjetzny's* method with fixation of the meniscus anterior to the joint. The patients responded favourably. *Becker* mentions the use of injections of sclerosing solutions in the treatment of subluxation of the temporomandibular joint and claims to have seen favourable results of treatment of about 100 joints, without, however, giving any further account of the cases. He states that he has opened "many" joints subject to recurrent dislocation and found "severe capsular changes". *Myrhaug* in 1954 reviewed the various methods of treatment, to which he adds yet another. He proposes to facilitate spontaneous reduction by diminishing the articular eminence by partial chisel-

ing. The method shows of inventiveness, but cannot be recommended.

The author has tried routine *injections* of slynasol, usually with satisfactory results. Where these fail capsulorrhaphy and tenotomy of the external pterygoid muscle are performed practically always with good effect.

#### TEMPOROMANDIBULAR ARTHRITIS

Acute arthritis as a complication of general infections: gonorrhoea, measles, scarlet fever, and sepsis has been reported, but seems to be relatively rare. The author has seen a few cases of ankylosis caused by suppurative arthritis in association with septic infections in infants, and a single case of acute pyarthrosis of unknown origin in an adult. An inflammatory process spreading to the joint from the adjacent organs, in the first instance chronic suppurative otitis media, may also give rise to destructive arthritis. *Northrop*, among others, has reported such a case, and the author has also observed ankylosis of this aetiology. The introduction of the highly active antibiotics has presumably reduced the frequency and importance of these complications.

*Rheumatoid arthritis* is stated by *Bayles* and *Russel* to involve the temporomandibular joint in 50 per cent of cases. The prognosis is judged to be relatively good and ankylosis rarely develops. In 1953 *Horten* described attempts to treat the patients by intra-articular injection of hydrocortisone. He reports three cases. The response seems doubtful, though *Horten* himself considers the method worth further trial. In a case reported by *Oshrain* and *Sackler* condylectomy had to be performed for ankylosis after all other treatment, including cortisone, had proved ineffective.

#### TEMPOROMANDIBULAR ARTHROSIS

A number of diseases with symptoms in the temporomandibular joint as well as an increasing number of regional and more general symptoms have during the past 15 to 20 years been grouped under the name of arthrosis, cf. the so-called *Costen's* syndrome with subsequent additions. Because of the close func-

tional relationship between the temporomandibular joint and the bite conditions, especially the supposed importance of malocclusion and bite displacement on the development of mandibular joint disorders, these problems have been dealt with chiefly by odontologists. They have interested some otologists and a few general surgeons, but hardly any physicians. An overwhelming literature is available, but it varies considerably in quality. A very large proportion is a quite uncritical accumulation of casuistic reports, often based on few and inadequately examined cases. In addition, many writers have advanced rather bold, purely speculative theories without having sufficient special knowledge. No wonder, therefore, the whole problem is marked by utter confusion. However, we also find papers giving a detailed account of fairly large thoroughly examined and critically analysed series of cases. In several of these papers it is emphasized that a great number of the central clinical problems of mandibular joint disorders are obscure, and that continued investigations are required.

The syndrome at present commonly designated as temporomandibular arthrosis by no means corresponds to the general-medical concept of arthrosis. The purely symptom-describing designations, such as "clicking jaw" previously employed are therefore actually preferable.

The pathological basis for the so-called mandibular joint arthrosis is as yet in the main unknown. Anatomical examinations at autopsy are seldom possible, and during operations on the temporomandibular joint there is as a rule only a very limited chance of examination of the joint. Histological examinations of the disks removed by operation have not given elucidative results. X-ray examination rarely gives a clue to the nature of the disease. In the great majority of cases the roentgenograms reveal no abnormality apart from the very doubtful anomalies of position of the condyle in the joint cavity. Structural changes in the bony parts of the joint, manifesting themselves on X-ray examination, are not seen in the so-called typical case of arthrosis.

There is no doubt that a number of the cases designated routinely as arthrosis are not joint lesions at all, but muscular affections and infiltrations localized particularly in the masticatory muscles, and related pathogenetically to bite defects and

masticatory habits. In the author's opinion, it is chiefly within this group of the so-called arthroses — which presumably constitutes the main proportion of these joint disorders — that bite-correcting treatment is of such essential importance.

Bite defects are doubtless largely responsible for a considerable proportion of the diseases usually designated as mandibular joint arthrosis. So many reports of favourable response to bite correction are available that a relationship cannot be denied.

Considering the overwhelming frequency of bite displacements, especially the frequency of gross defects which do not give rise to mandibular joint disorders, it is evident that other factors also must play an essential part; but these are as yet in the main unknown.

It seems inappropriate to diagnose as "mandibular joint arthrosis" the disorder, occurring with increasing frequency, for which psychological factors are considered to be mainly responsible. With the increasing attention given to mandibular joint symptoms both by the laity and particularly by the dental profession it is only natural that they have come to constitute part of the ordinary neurotic picture.

In this connection it is worth repeating that symptoms from the temporomandibular joints very often are transitory, subsiding spontaneously or following purely symptomatic treatment, so that the results of a more comprehensive "causal" treatment must be assessed with great caution.

*Markovitz* and *Gerry*, in their previously mentioned ample survey and discussion of the literature, in connection with a report on a considerable number of their own cases, point out and accept the commonly held view that abnormalities of occlusion constitute the most important aetiological factor. *Staz*, in an excellent work, based on a large, personally examined series, also found that the great majority of the patients recovered after bite-correcting treatment, primarily correction of the height of the bite. 84 per cent out of 328 treated patients recovered. *Staz* emphasizes, however, that further investigations are required to make clear what is normal and what is abnormal with regard to the position of the condyle in the fossa and to get a more precise idea of the mechanism of the mandibular joint movements. It is appropriate here to again refer to *Hjortsjö's* works.

In the Scandinavian countries the mandibular joint disorders have, as elsewhere, been a subject of animated discussions. *Lindblom* especially has displayed a considerable interest in these questions. In a comprehensive work from 1951 he defines the concept of "arthrosis" on a purely symptomatic basis, disregarding possible degenerative changes, because investigations with these in view have been found to be impossible.

In *Lindblom's* opinion, many causative factors are involved, some of which lie outside the field of odontology, being of a more general-medical nature. He attempts to throw some light on "the causal complex of the so far obscure mandibular joint troubles". Though he cannot be said to have succeeded, his sober recognition and emphasis of the obscurity of many of these conditions is highly commendable and certainly will prove useful.

*Lindblom* attaches great importance to X-ray examination and believes that if his technique is used, it is possible to draw definite conclusions from the position of the condyle in the fossa. As previously stated, the author disagrees with *Lindblom* on this point.

The most frequent bite defect in *Lindblom's* series was that of forced movement with deviated bite. Treatment with heat, grinding in of the bite and temporary or permanent bite reconstructions gave good results in all the (40) cases where dental causes were demonstrable. It is emphasized that if dental causes are not demonstrable and neurological complaints predominate, no improvement can be expected from dental therapy.

*Posselt* in a number of papers deals with mandibular joint arthrosis and its functional treatment. He stresses the importance of always trying to carry this through rationally before contemplating surgical intervention.

*Ireland*, proceeding from the usually accepted points of view, gives an account of the mechanism of development of mandibular joint disorders on the basis of malocclusion and dysfunction, and he deals at length with reconstruction of the bite and treatment by bite splints.

*Surgical treatment* of mandibular joint arthrosis is seldom indicated. Of *Markovitz* and *Gerry's* patients 6 per cent were submitted to operation, in the author's opinion a relatively high proportion. *Hankey's* choice of operative "exploration" of the

joint in 14 per cent must have been based on very wide indications, probably far too wide, according to current views.

Agreement now seems to prevail that operation is not indicated in the acute cases. The commonly accepted indications are pain, restricted movements, possibly dislocation and subluxation, and more rarely, pronounced clickling, if the symptoms cause much trouble and have persisted for some length of time without relief by conservative treatment. It is necessary to emphasize the importance of bite-correcting treatment when bite displacement has been found, and of relieving treatment in cases of dysfunction.

The most common operation is that of meniscectomy. *Boman* claims that the results of this operation are surprisingly good. *Dingman* and *Moorman* as well as *Kiehn* have also achieved favourable results. *Kiehn* even claims to have seen not only complete disappearance of the symptoms, but also normal function of the joint. This seems unlikely, however. *Nash's* hypothesis that arthritis can be prevented by early meniscectomy seems especially unlikely.

*Steinhardt* recently raised the question whether plastic operations of the mandibular joint in the form of "modelling arthroplasty" are indicated. He himself answered the question in the negative. He states that the deforming changes in the joint following removal of the disk are part of a process of reconstruction adapting the joint to its new gliding action.

In a few cases, however, ankylosis has been seen to develop following meniscectomy, necessitating subsequent condylectomy. Some quite modern writers are, in fact, of the opinion that when operation is indicated at all, condylectomy is usually the operation of choice (*Ireland, Henny*).

*Staz* doubts whether excision of the disk is ever indicated. He mentions that *Brown* proposes osteotomy at the base of the condyloid process to obtain pseudarthrosis at this point.

In recent years intra-articular injections of both *hydrocortisone* (*Henny*) and *hyaluronidase* (*Nathan*) have been suggested and tried, but too little experience has as yet been gained of these methods of treatment to allow of an evaluation of them.

Hypermobility of the condyle with *habitual subluxations* accompanied by clickling and pain, and occasionally fixation are

common symptoms in the syndromes usually included under the concept of mandibular joint arthrosis.

*Schultz* in 1937 proposed to treat such cases by injection of a sclerosing solution into the joint. In 1947 *Schultz* claimed to have achieved favourable results with "several hundred patients", without, however, giving details of the treatment. He used sylnasol in the majority of the cases.

*McKelweg* gave sylnasol injections to 100 patients, who responded favourably (75 per cent cured and 9 per cent improved), and he found the method simple with a negligible risk of complications. *Becker* also has considerable experience with injections, chiefly sylnasol, which have given favourable response. He recommends immobilisation by intermaxillary fixation for about 3 weeks after the injection. *Salman* has employed this method of treatment for 10 years, finding it effective "harmless and simple", without, however, giving details of the results. *Rosenbaum* gives a more exhaustive description of the method, but has only a very limited personal experience. Using sylnasol, he gives from one to five or six injections, usually into both joints, at intervals of two or three weeks.

The author has employed the method in about 25 cases, generally with good effects. Different sclerosing solutions have been tested. Sylnasol was found the most suitable, giving a relatively mild local reaction. Further, histological studies by *Mølhav* (personal communication) in animal experiments have shown sylnasol to be superior to other sclerosing agents.

#### TEMPOROMANDIBULAR ANKYLOSIS

Ankylosis is a not uncommon sequela of mandibular joint disorders. The condition is in itself highly disabling, and if occurring before the end of the growth period, it is often accompanied by very considerable and grave disturbances of growth of the mandible.

*Thorkild Rosing* in 1892 reviewed the cases published up to that time, a total of 24, to which he himself added another two. Inflammatory processes in the joint were the main causes of the ankylosis. It is remarkable that a relatively large proportion of the cases had occurred as a complication of general infections,

such as typhoid fever, scarlet fever, measles, diphtheria, whooping cough and puerperal sepsis. Rovsing at that time pointed out that in cases of unilateral ankylosis the other temporomandibular joint will as a rule remain movable despite often prolonged immobilisation, caused by the rigidity of the affected joint. He advocated surgical treatment in the form of resection of the joint.

The steadily increasing interest during recent years in mandibular joint disorders in general resulted in publication of various minor papers on ankylosis. In 1938 *Kazanjian* reported on a series of 33 cases treated in the course of 15 years. Some of these patients seem not to have presented true ankylosis, however, but fixation of the mandible due to extra-articular lesions. In *Kazanjian's* opinion, operation in early childhood may possibly limit the deformity. He stresses the risk of injuring the middle cranial fossa when removing the condyle in cases of bony ankylosis. In a subsequent paper *Kazanjian*, in collaboration with *Converse*, further discusses the problems of mandibular joint ankylosis. *Thoma* also recommends early operation to counteract malformation. *Dingman*, in agreement with many other workers, feels that operation is the only possible treatment for ankylosis. Forceful manipulation has no effect.

*Padgett*, *Robinson* and *Stephenson* have reported 22 cases, of which 16 were true (i.e. intra-articular) ankylosis. Infection was the most frequent cause, and the treatment was resection.

*Parker* has given a good general survey of the problem of ankylosis, without, however, going into details of his personal experience, confining himself to stating that he has seen good results over a number of years. He emphasizes that prolonged immobilisation should be avoided in cases of injured condyle because of the chance of ankylosis, and that operation is the only effective treatment, during which it may be necessary to excise the coronoid process as well. *Straith* and *Lewis* report 16 cases, the majority in children. Injury and infection were the most common causes. *Smith* states that 50 per cent of all cases appear before the age of 10 years, but they are rarely submitted to treatment until 10 to 20 years later. He points out that rheumatic diseases occasionally affect the temporomandibular joint and may lead to ankylosis.

Ankylosis is commonly stated to be due in the main to intra-

articular condylar fracture and to infection. As previously mentioned, rheumatic diseases may also, though relatively rarely, result in mandibular joint ankylosis. *Braithwaite* and *Hopper* hold that X-ray treatment possibly may give rise to fibrous ankylosis. However, one may ask whether the disease for which X-ray treatment is given is not the more likely cause of the ankylosis? *Joseph* reports a case of mandibular joint ankylosis in association with ankylosing spondylitis, and states that such cases have previously been described.

So-called extra-articular or false ankylosis may be due, among other things, to displaced zygomatic fractures (*Kazanjian* and *Converse*, and others) or pathological processes in the coronoid process (*Shackelford* and *Brown*). In cases of true ankylosis the coronoid process is often involved (*Martin*).

In the author's experience the most frequent cause of mandibular joint ankylosis is a non-specific inflammation of the joint, either due to spread of inflammatory processes from adjacent structures especially otitis media, or of metastatic origin, possibly in association with general infections. Another important group of causes is that of intra-articular lesions due to severe traumatic injuries, among them birth injuries during forceps delivery.

Mandibular joint arthrosis in advanced cases may give rise to ankylosis, usually fibrous, more rarely bony.

The *symptoms* of ankylosis are in the first instance restricted movement or total immobility. It is surprising that a certain, though slight mobility may persist even in cases of massive bony ankylosis. The anterior teeth may be separated from a few to five mm with simultaneous marked deviation towards the affected side. The oral hygiene is exceedingly poor and treatment of the teeth impossible, so that they are nearly always in a very bad state. This condition is further accentuated by the frequently associated deformity of the mandible causing complete destruction of the occlusal relationship.

The deformity of the lower jaw manifests itself particularly by a more or less pronounced hypoplasia of the mandible on the ankylosed side. It is the more pronounced the earlier in the patient's life the ankylosis has developed. Bilateral ankylosis gives a very marked deformity which is both functionally and

aesthetically disadvantageous with a greatly retracted chin, associated with excessive irregularity. The deformity is very expressively designated as "Vogelgesicht" or "Andy Gump Chin".

*The cause of the deformity* of the mandible frequently accompanying mandibular joint ankylosis has been a subject of dispute, and complete agreement has not yet been reached. Many investigators have considered the impaired function of the lower jaw responsible. This view has, however, been increasingly challenged in recent years. *Kazanjian* emphasized as early as in 1938 that the non-affected joint in unilateral ankylosis remains movable for years, that the non-ankylosed side develops normally and that no deformity is seen in association with immobility of the jaw from extra-articular causes. He is therefore of the opinion that the function plays no essential part, but that the deformity is due predominantly to destruction of the growth zone.

*Rushton* is of the opinion that the abnormal or abolished function cannot be left entirely out of account. *Engel* and *Brodie* have advanced similar views. *Sarnat* and *Engel*, who have examined the growth after removal of a condyle in monkeys, also found evidence in support of the view that the ankylosis is not the cause of the deformity.

There can probably no longer be any doubt that the failing function is not the real cause of the hypoplasia, but that this is due to destruction of a growth centre in the condyle, so that the ankylosis and the deformity are parallel disorders due to the same cause.

Mandibular joint ankylosis is treated by surgical intervention. It is universally agreed that any form of manipulation either short and intense or gradual and prolonged, gives a chance of lasting improvement of the mobility.

#### DIFFERENTIAL DIAGNOSIS

Symptoms in the mandibular joint region may often give rise to considerable and difficult diagnostic problems. It has previously been mentioned how many workers have tried to relate more and more vague symptoms, often located far from the

joint, to mandibular joint disorders, especially to the undefined concept of "mandibular joint arthrosis".

On the other hand, symptoms pointing directly to a mandibular joint disorder may not infrequently prove to have a quite different cause.

That muscular tension of "nervous" origin and muscular dysfunctions and infiltrations from other causes may give rise to symptoms usually referred to the joint has already been mentioned. Muscular spasms in tetany and strychnine poisoning may cause pronounced maxillary constriction. Similarly, acute anterior poliomyelitis may cause limited opening movement.

Since patients suffering from mandibular joint disorders often refer their symptoms to the ears, and, on the other hand, diseases of the ear may very well give pain and tenderness subjectively referred to the joint, the differential diagnosis between these two groups of affections is important in both respects. Co-operation with otologists will therefore often be desirable in these cases. Tenderness of a pre-auricular lymph node associated with pain on movement of the condyle may mistakenly give rise to suspicion of a mandibular joint disorder. The author has seen a few cases of temporal arteritis (Horten's syndrome) and of angioma in the temporal bone which were for some time regarded as mandibular joint disorders.

More common are mistakes in cases of restricted opening movement due to extra-articular lesions. The latter quite frequently are fractures with depression of the zygomatic bone or lesions in which the coronoid process is involved.

#### OPERATIVE SURGERY OF THE TEMPOROMANDIBULAR JOINT

Operative access to the temporomandibular joint is difficult owing to the risk of injuring the facial nerve. A variety of incisions have been suggested to avoid this. They are of three types: vertical or angular incisions anterior to the ear; retro-auricular incisions with transsection of the external auditory meatus with mobilisation of the external ear anteriorly (*Bockenheimer—Arhausen*); and endaural incisions (employed by *Costen*, according to personal communication 1955). All these routes give a sufficiently wide access to and a good view of the temporomandibular

joint. The choice of one or the other is therefore largely a matter of personal judgement. The author formerly preferred Bockenheimer—Axhausen's incision, which carries minimal risk of injury to the nerve, and with uncomplicated healing, gives hardly any visible scar. After encountering a few instances of meatal stenosis due to the cicatrix and the inconvenience to some patients caused by the almost complete and prolonged numbness of the external ear, the author has changed to a vertical incision about four cm long anterior to the ear, supplemented, if necessary, by a horizontal extension from the upper end of this incision forwards along the zygomatic arch. By this incision the nerve is also relatively safe from injury and it gives fine, practically invisible scars. The *bleeding*, which is seldom copious, can as a rule be controlled by ligation in the wound or by tamponade for a short period. It is rarely necessary to leave the tampon in the cavity for as long as a few days. If this is necessary it is generally because of injury to a venous plexus on the anterior aspect of the joint. In two out of 150 arthrotomies the author had to ligate the external carotid to control the bleeding with sufficient certainty. The internal maxillary artery had probably been injured in these cases.

The operation most frequently performed on the temporomandibular joint is doubtless that of *arthrotomy with removal of the disk* in cases of so-called arthrosis, when conservative treatment especially bite-correction has proved inadequate. The most detailed account of this treatment has been given by *Boman* based on 58 patients. The results are claimed to be good, but the method of assessment is not quite convincing. *Dingman* and *Moorman* report 12 cases submitted to excision of the disk, with good response in 11, while one patient later had to have condylectomy done for ankylosis. *Dingman* has since supplemented this number of cases by another 15, which responded favourably. *Kiehn* operated on 15 patients who obtained freedom from symptoms and "normal function of the joint".

Excision of the disk has received wide recognition. Various writers, among them *Steinhardt*, have even stated that both joints should be operated on in cases of unilateral mandibular joint disorders. Criticism has not been wanting, however. *Staz*, for instance, doubts whether excision of the disk is ever indicated. He

quotes *Brown*, who prefers osteotomy at the base of the condyloid process in order to produce pseudarthrosis at this point.

*Henny* advocates condylectomy instead of excision of the disk in the relatively small group where operation is indicated at all. *Ireland* does the same.

*Condylectomy* is the only effective treatment for ankylosis. Very often interposition of tissue is combined with the resection. *Pickrell*, *Wilde*, *Edwards* and *Broadbent* interpose muscular tissue and others, e.g. *Kazanjan*, *Straith* and *Lewis*, use fascia. Some writers maintain that interposition of tissue is unnecessary (*Padgett*, *Robinson* and *Stephenson*, *Dingman*, *Smith*).

*Parker* fills the space after condylectomy with gauze tampons, which are removed successively during the following weeks. He further places a bite block distally on the operated side, to prevent upward tipping of the mandible on this side. *Braithwaite* and *Hopper* point out the risk of injuring the base of the skull on removing the condyle in cases of broad bony ankylosis. They advocate osteotomy lower down the ramus and interpose bovine cartilage. *Kazanjan* has also called attention to this risk.

*Stuteville* has attempted reconstruction of the joint by bone grafting, but his report affords no basis for an evaluation of the results. In recent years some writers, among whom *Gottlieb*, *Goodsell*, *Smith* and *Robinson*, as well as *Wang—Norderud*, have published communications on alloplasty as a substitute for the excised condyle. It is as yet impossible to judge the results, which, however, so far seem rather discouraging.

*The function* of the temporomandibular joint *after excision of the disk* is generally claimed to be good. A few writers, e.g. *Kiehn*, even speak of a "normal" function. It is also the author's experience that the function after removal of the disk is surprisingly improved. In the great majority of cases freedom from pain and good mobility are obtained, the function being thus practically unimpeded. The movement of the treated joint is somewhat restricted, however, opening taking place with deviation of the jaw towards the operated side, and the horizontal movement towards the opposite side being limited or totally abolished. The occlusion, on the other hand, is generally preserved.

X-ray examination nearly always shows gross anatomical

changes in the joint, in addition to the restricted mobility of the condyle. As pointed out by *Steinhardt*, this is presumably indicative of a natural reconstruction of the joint.

The function is also usually excellent after unilateral condylectomy. The asymmetry of the movements is somewhat more pronounced, but occlusion is generally normal. Not infrequently, however, a certain tipping of the mandible is seen, necessitating prosthetic corrections of some kind. Bilateral condylectomy is inadvisable. Because of the eccentric displacement of the mandible and the tendency to tipping with open bite anteriorly a satisfactory bite is often difficult to obtain.

#### SUMMARY

The need for a critical review and evaluation of the very extensive literature on mandibular joint disorders during the past 25 years is pointed out. The frequent occurrence is mentioned of transitory symptoms from the temporomandibular joints, which subside spontaneously. Mention is made of the part played by the masticatory muscles in troubles often attributed to the temporomandibular joint, and attention is called to the fact that various lesions, often extra-articular, may also cause symptoms mistakenly referred to the joint.

Pain, clicking on movement and abnormal mobility (too little or too much or other deviations from the normal) are regarded as true articular symptoms. The regional symptoms are described, with special reference to the so-called Costen's syndrome; and a warning is given against the uncritical inclusion of greatly differing, often very doubtful complaints under this concept.

X-ray examination of the temporomandibular joints is difficult, and the films must be assessed with great caution. Comparison of pictures of different joints or taken at different times is very difficult.

The significance of radiography in determining the position of the condyle in the joint has been greatly overestimated.

The various surgical disorders of the mandibular joint are described: Deformities, fractures, dislocations, subluxations, arthritis, ankylosis. Special mention is made of the so-called mandibular joint arthroses.

Some special difficulties in differential diagnosis are discussed. Finally, a brief account is given of the operative surgery of the temporomandibular joint.

#### RÉSUMÉ

#### AFFECTIONS CHIRURGICALES DE L'ARTICULATION TEMPORO-MAXILLAIRE

L'auteur souligne la nécessité d'une révision et d'une estimation critique de la vaste littérature des 25 dernières années sur les affections de l'articulation temporo-maxillaire. Il signale la fréquence des cas où des symptômes passagers de l'articulation temporo-maxillaire disparaissent spontanément. L'auteur signale le rôle des muscles masticateurs dans l'apparition des gênes que l'on impute souvent aux articulations temporo-maxillaires, et attire aussi l'attention sur le fait que diverses affections extra-articulaires peuvent par ailleurs déterminer l'apparition de symptômes que l'on rapporte à tort à l'articulation.

Sont considérés comme symptômes articulaires proprement dits: douleurs, craquements à l'occasion des mouvements et troubles de la mobilité (mobilité trop limitée, trop grande ou anormale d'autre manière). L'auteur mentionne les symptômes régionnaires, en particulier en ce qui concerne ce qu'on appelle le syndrome de Costen, et met en garde contre la considération sans critique de l'ensemble des plaintes les plus diverses, et pour la plupart fort douteuses, qui y sont rattachées.

L'examen radiographique de l'articulation temporo-maxillaire est difficile, et l'interprétation des clichés doit être faite avec la plus grande prudence; la comparaison de différentes articulations ou de clichés pris à des moments différents soulève de grandes difficultés.

L'importance de la radiographie pour la détermination de la position du condyle dans l'articulation a été fortement surestimée.

L'auteur mentionne les différentes affections de l'articulation temporo-maxillaire du ressort de la chirurgie: malformations, fractures, luxations, subluxations, arthrites, ankyloses; mention spéciale est faite de ce qu'on nomme les arthroses temporo-maxillaires.

Quelques problèmes plus spéciaux posés par le diagnostic différentiel sont l'objet de quelques mots et une courte mention est enfin faite de la technique chirurgicale de l'articulation temporo-maxillaire.

#### ZUSAMMENFASSUNG

##### CHIRURGISCHE KRANKHEITEN DES KIEFERGELENKES

Es scheint erforderlich zu sein, die umfangreiche Literatur der letzten 25 Jahre über Kiefergelenkerkrankungen einer kritischen Revision und Wertung zu unterziehen.

Das hinlänglich bekannte Auftreten vorübergehender, jedoch spontan wieder verschwindender Symptome seitens der Kiefergelenke wird besprochen. Es wird auf die Bedeutung der Kau-muskulatur für das Entstehen von Störungen, die häufig den Kiefergelenken zur Last gelegt werden, hingewiesen und darauf aufmerksam gemacht, dass verschiedene Erkrankungen ausserhalb dieser Gelenke Symptome hervorrufen können, die irrtümlicherweise ursächlich mit den Kiefergelenken in Verbindung gebracht werden. — Schmerzen, Knacken bei Bewegungen und abnorme Beweglichkeit überhaupt sind als eigentliche Gelenksymptome anzusehen. Die regionalen Symptome speziell im Hinblick auf das Costen'sche Syndrom werden erörtert, und es wird davor gewarnt, eine kritiklose Aufzählung höchst verschiedener, teils sehr zweifelhafter Klagen unter diesen Begriff fallen zu lassen.

Die Röntgenuntersuchung der Kiefergelenke ist schwierig. Die Beurteilung der Aufnahmen hat mit grösster Zurückhaltung zu geschehen. Es ist ausserordentlich schwer, Vergleiche unter sowohl zeitlich ebenbürtigen als auch zeitlich verschiedenen Gelenkaufnahmen anzustellen. Die Bedeutung der Röntgenuntersuchung zur Beurteilung der Stellung des Condylus im Gelenk wird meistens stark überschätzt.

Verschiedene chirurgische Kiefergelenkerkrankungen wie Missbildungen, Frakturen, Luxationen, Subluxationen, Arthritis und Ankylose werden besprochen. Den sogenannten Kiefergelenkarthrosen ist besondere Aufmerksamkeit gewidmet worden.

Einige Probleme mehr spezieller, differentialdiagnostischer Natur werden erörtert und abschliessend ein kurzer Abriss der operativen Kiefergelenkchirurgie gegeben.

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