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Received: 17 September, 2018

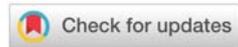
Accepted: 12 October, 2018

Published: 13 October, 2018

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Keywords: Temporomandibular joint; Luxation; Axiography; Magnetic resonance imaging

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Review Article

Subluxation of temporomandibular joint- A clinical view

Abstract

In the temporomandibular joint (TMJ) with physiological disc position, the disc rotates posteriorly on the condyle to the maximum degree and the condyle translates to the maximum degree, which occurs simultaneously at the maximum mouth opening movement. Condylar hypermobility in the position of maximally open mouth leads to the subluxation of the joint, and the two terms can thus be considered synonyms. The predisposition of the morphological relations of the zenith of the articular eminence and the contours of the articular surfaces lead to an excessive anterior displacement of the condyle over the zenith eminence. In addition, the irregular movement of the disc-condylar complex can also occur. The aim of this paper is to explain the hyperextension of TMJ which may, along with anatomical predisposition to the maximally open mouth position, lead to subluxation or luxation of the joint. Subluxation is not associated with a specific pathological characteristic of the joint. However, apart from discomfort, a subluxation can also cause pain. The excursive movement of the condyle close to and over the individual opening limit can lead to stiffness of joints and the inability to open the mouth (open lock), which is a prominent clinical sign of TMJ luxation. Electronic axiography can show pathological hyperextension of the condyle, while x-ray diagnostics records the condition of subluxation. A spontaneous luxation is clinically evident and therefore radiological diagnosis is used only to confirm the condition. Magnetic resonance imaging shows the disc and in the position of the maximally open mouth, thus giving the responses of the disk relation to the hypermobile condyle. Therapeutic modalities include occlusal splints and oral appliances, physiotherapy, and the mouth opening self-control. The goal of the treatment is relaxation of the masticatory muscles, removal of pain in the joint and muscles, and better coordination of movement, particularly in cases when there is a predisposition of spontaneous luxation.

Introduction

The International Association for the Study of Pain defines temporomandibular disorders (TMDs) as a form of musculoskeletal pain in the orofacial region, i.e., mucosal muscles and temporomandibular joint (TMJ) [1]. Diseases of TMJ are redefined by diagnostic systems according to Diagnostic Criteria for TMD (DC / TMD) [2-4]. Hyperextension of the condyle at maximum opening of the mouth leads to subluxation and luxation of the joint.

In hypermobility the condyles are positioned over the articular eminence resulting in a skip of the condyle complex during the terminal opening of the mouth. In luxation, there is also a partial or complete inability to close the mouth. The cause of these changes is often the predisposition of the osseous condylar surfaces, and the "weakness" of the ligament and muscle structure [5]. The aim of this paper is to explain the hyperextension of TMJ which may, with anatomical predisposition to the maximally open mouth position, lead to subluxation or luxation of the joint.

Biomechanics of the temporomandibular joint

The normal anatomy of the joint allows a relatively smooth movement of the condyle which translates downwards and across the articular eminence. A subluxation will occur in a TMJ whose articular eminence has a relatively short steep posterior slope (the functional side of the joint), whereas the anterior surface of the articular eminence has longer and less steep slope. In the hypermobile (subluxation) joint, the maximum of the rotational movement of the disc is achieved before the maximum translation of the condyle due to a steep eminence. As the mouth opens wider and wider, the last part of the translational movement emerges as a sudden skip accompanied by a dumb sound of condylar complex sliding over the crest of the articular eminence [5,6].

In a luxation or dislocation of the TMJ, the mouth opens over its normal boundary, the mandible is blocked and it is called *open lock* or spontaneous luxation of the condyle and the disk complex [7]. The excessive opening of the mouth upon yawning, singing, or during dental procedures leads to this

condition. In a spontaneous luxation, the patient cannot close the mouth independently, and this can be explained by the anatomy of the articular eminence that permits a previously long-lasting subluxation (hypermobility) on wider mouth opening. In the same fashion as with subluxations, the disc rotates before the maximum translation of the condyle when the mouth opens up to its maximum limit [5].

Clinical diagnostics

Generally, clinical diagnostics and patient history are the basis for diagnosing musculoskeletal disorders [8]. While luxation is evident in clinical practice because the patient is unable to close his mouth on his own, subluxation (hypermobility of the condyle) is only partially a pathological condition, that is, if there is pain and discomfort in the joints and masticatory muscles. The classic clicking sound in the terminal phases of mouth opening can be a sign of subluxation of the condyle which travels anteriorly along the articular eminence in order to adapt.

On clinical examination, apart from palpation of the joints and measurements of the mouth opening, it is possible to additionally assess the involvement of the disc in condyle mobility derangement and its relation to the disc with its articular surfaces using specific methods of joint examination in form of manual/structural functional analysis [9,10]. The relationship between the disc and the condyle complex is being determined by dynamic compression of the joints during the opening (excursive gliding movements) and the closing of the mouth (incurive gliding movements), thus confirming the occurrence of pain in the condyle as well as its hypermobility. However, a clinically valid status of the disc is questionable due to variability of the relationship between the condyle and the disc (different forms of anterior displacement of the disc, posterior displacement of the disc). The incurive clicking sound indicates a discontinuity in disc travelling (compared to the hypermobile and anteriorly positioned condyle in relation to the disc at the beginning of the mouth closing). Bumann and Groot Landeweer [10] described this intraarticular condition as disc displacement occurring in the course of excursive movements. The hypermobility of the condyle leads to the so-called lateral dislocation of the joint. This is noticeable on the physiognomy of the face as a protrusion of the condyle which can be emphasized by narrowing of the face in the region between the zygomatic arch and the cheek (Figure 1).

The patients come to the office in a state of luxation, with their mouths permanently open. Since they are unable to close their mouths, the patients are usually very upset about this situation. There are signs and symptoms occurring in patients during maximum mouth opening, whereby the lateral poles of the condyle jump forward (i.e., subluxation), thus leading to inability to close the mouth, excessive salivation, tension and spasm in the masticatory muscles and pain in the TMJs [11].

Instrumental movement analysis

There are numerous possibilities for analyzing the stomatognathic system within the instrumental functional

analysis, out of which the kinematic aspect of the mandible is very important for detection and visualization of subluxation. In contrast to the sagittal and frontal anterior guidance angle, the determination of movement capacity implies measuring the maximum movement possibilities (e.g. mouth opening movements) until the so-called neuro-muscular border movements. There are several electronic recording systems (axiographies) for the registration of the mandibular movements based on the ultrasonic measuring device (e.g. ARCUSdigma II, KaVo, Biberach, Germany) [12,13].

In addition to the amount of movement (the quantitative characteristic of the movement along with the symmetry analysis of the performance for the left and right condyles), axiography also shows the qualitative relation which is projected by condyles on the movement curvature (anterior concave curvature is a characteristic of the physiological mobility of the condyle). The condylar path length is observed for the hypermobility of the condylar pathway, which in this case is lengthened (Figure 2) [14]. Looking at other diagnoses of TMJ disorders, the recording of condylar movement has greater specificity (true negative results) than sensitivity [15].

So far, the clinical relevance of computer axiography has been mostly in the assessment of the anterior disc displacement diagnosis. It is indicative for anterior disc displacement with reduction that the opening and closing mouth movement is cross tracing [13]. A reduced amount of mouth curvature as



Figure 1: Lateral dislocation of condyle (arrow) affects the patient's physiognomy: closed (a) and open (b) mouth.

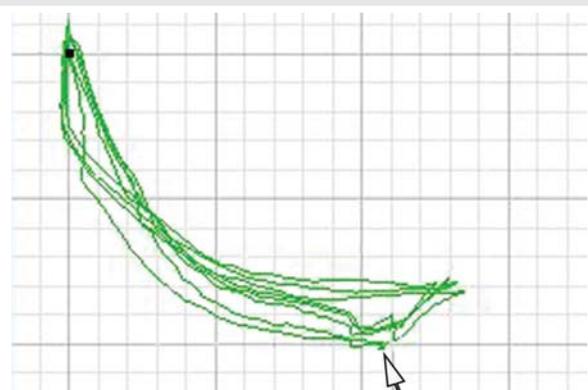


Figure 2: Clicking (arrow) in the right TMJ confirmed by 'motion analysis' module (Arcus Digma II, KaVo) (with permission from [14]).

well as straight-line tracing is closely related to diagnosis of the anterior disc displacement without reduction, rather than osteoarthritis. A posterior convex or inverse curvature suggests osteoarthritis. The speed of condylar movement is typically divided into the movement of the mouth opening up to an increased travelling speed until reaching the maximum mouth opening position [16,17].

Radiological diagnostics

For the purpose of diagnosing TMJ disorder, it is important to note that radiological diagnostics is undoubtedly an enhancement of clinical diagnostics, and that magnetic resonance imaging (MRI) is the gold standard for disc displacement diagnostics. Generally, for the condyle hypermobility diagnosis, it is undoubtedly necessary to choose an adequate method of functional representation of the joint. This includes a representation of the joint on two images, in the close mouth and open mouth positions [18].

A conventional panoramic radiograph (orthopantomogram, OPG) has no significance for the subluxation diagnostics but panoramic TMJ-program (TMJ-field OPG program) offers a targeted bilateral view of the condyle on the panoramic x-ray unit in orthoprojection on close mouth and open mouth positions (Figure 3). Therefore, transcranial images of TMJs by Schüller are no longer the first choice of x-ray diagnostics due to excessive radiation. The image by Schüller represents an axiolateral image of a skull at an angle of 25-30 ° which is trying to avoid bone superimposition. Currently, it represents the classic method of choice for x-ray diagnostics in the TMJ hyperextension [10].

Since luxation / subluxation is a matter of bone structure disorders, the mobility of condyles in the open mouth position relative to the articular eminence is evaluated as hypomobility, normal mobility (condyle reaches the lowest part of the articular eminence) and hypermobility up to the state of expressed hypermobility. The lightweight and pronounced hypermobility of the condyle is the subluxation position of the condyle anteriorly from the zenith of the articular eminence or completely in front of it [19].

Instead of multi-slice computerized tomography (CT) in dental radiology, the priority has the choice of method that is easily used and has a reduced radiation dose: cone beam CT (CBCT). However, CT is not a suitable method because double exposures (closed and open mouth) would expose the patient to a double dose and thus to a significantly higher radiation dose than classic x-ray diagnostics. The use of CBCT to show the hypermobility of the condyle (Figure 4), can be planned in the case of diagnosis of other orofacial pain of high intensity, whereby the position of the articular bodies in the closed mouth is not recorded [19].

MRI is the gold standard for soft tissue diagnostics, which includes disk malposition (various forms of disc displacement) and joint effusion. MRI is not the first choice in diagnostics of the changes occurring in bones (osteoarthritis) [20, 21]. It is the most expensive modality in TMJ diagnostics. Because of

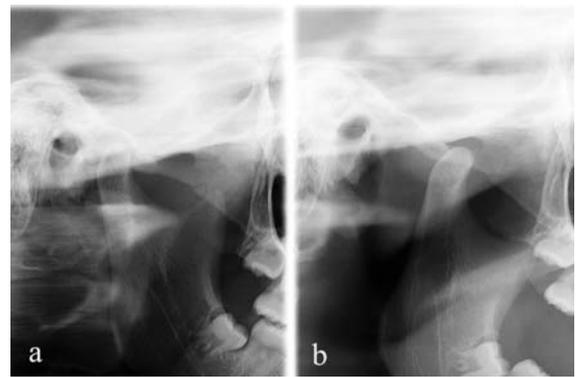


Figure 3: Temporomandibular joint performed on an orthopantomogram device: closed (a) and open (b) mouth.

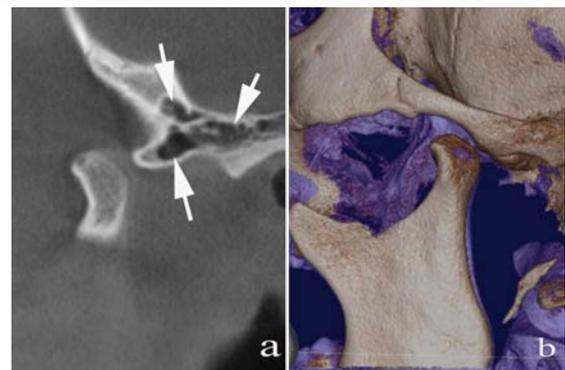


Figure 4: Cone beam computerized tomography shows condylar position in subluxation (open mouth): layered representation in parasagittal plane (a) and three-dimensional representation (b). Note: arrows show zygomatic air cell defect.

the long duration of recording by sequences (closed and open mouth), the patient's discomfort and his need for saliva, it can result in technically bad images.

Apart from the shift of the condyle, the disc is also visualized in MRI diagnostics and its position in closed and open mouths is compared (Figures 5,6). The closed mouth position is referred to as condition for determining disc disorder. MRI has a significant role when there is a doubt about the variations of hypermobility of condyles with disc displacement during excursive movements according to Bumann and Groot Landeweer [10], which has been stated in the literature in the context of clinical differential diagnosis. If the disc is displaced laterally on a subluxated condyle (in the open mouth position), and in physiological position of closed mouth, it is not a posterior displacement of the disc (Figure 7) [22].

In conclusion, clinical examination is essential for the subluxation diagnosis, whereas MRI as a radiological method confirms the clinical finding. If TMJ is affected and painful apart from hypermobility there is a finding of disc displacement and / or osteoarthritis confirmed by MRI, then subluxation is not a primary diagnosis that is responsible for the patient's illness. According to DC / TMD criteria, it is possible to make a number of clinical diagnoses of TMD in one patient. Nevertheless, radiological diagnosis is also required for a definitive confirmation of the condition in the joint during the mouth opening.

Therapeutic modalities

The patient's self-awareness in the course of achieving the maximum opening movement and his/her efforts to avoid any subluxations are certainly of crucial importance for the success of any therapy. Frequently, the self-help of patients with luxation consists of a pronounced change in their oral behavior. They make efforts to control the condition by decreasing the opening of the mouth. In cases of painful subluxations, it is possible to start treatment with a Michigan (stabilizing) splint for the purpose of relaxation of the muscles, increase of the vertical size of occlusion and repositioning of the joints in the

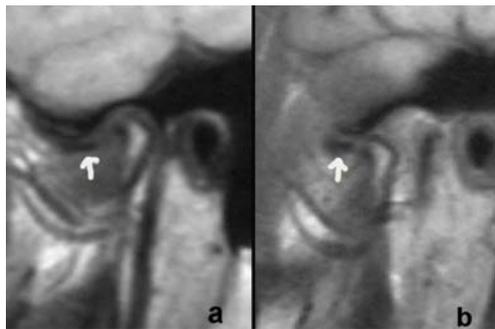


Figure 5: Magnetic resonance image of a temporomandibular joint in the closed (a) and open mouth (b) position. Hypo mobility of the condyle is related with anterior disc displacement without reduction.

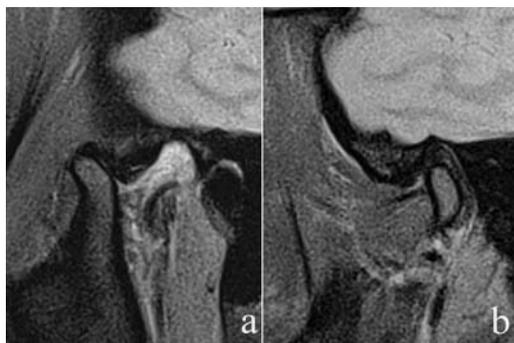


Figure 6: Magnetic resonance image of a painful TMJ in the closed mouth position (a) has a physiological relationship between the condyle and the disc. In an open mouth position –subluxation (b), the disc follows simultaneously the condyle hyperextension.

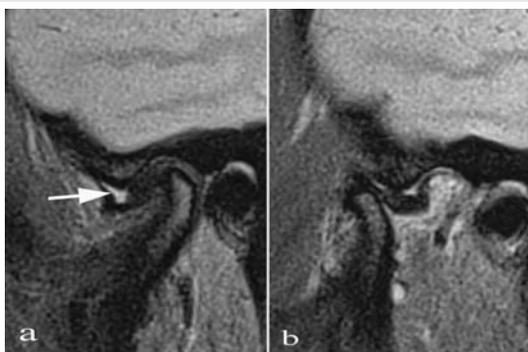


Figure 7: Magnetic resonance image of a painful TMJ in closed mouth (a) shows anterior disc displacement. In the open mouth position (b), the disc lags behind for hyperextended condyle. Although the disc is now in posterior position, it is not a diagnosis of posterior disc displacement. Note: The arrow shows the effusion.

closed mouth position. Although such an occlusion splint does not change the maximal movement of the joint, it affects the treatment of pain in the same way as in other intraarticular disorders [23,24]. Physiotherapy, particularly kinesiotherapy by Schulte, affects the musculature and joint kinetics, and regular, but not excessive exercise affects the coordination of maximal movements of TMJs. Other physiotherapeutic methods of analgesia are recommended, while the use of transcutaneous nerve stimulation (TENS), due to sensitivity of the orofacial area to electric current, is not recommended [25].

In spontaneous luxation, an imperative of oral behavior is to have constantly limited amount of daily movements of the joints. Thus patients become afraid of unpleasant spontaneous luxation, which leads to contractions of the masticatory muscles if manual repositioning is not applied. It is then necessary for the dentist to help because the repositioning is performed with the previous relaxation of the muscles by anxiolytics. It is possible to limit the opening of the mouth using mechanical oral devices that bimaxillary limit the excessive amount of mouth opening. Spontaneous luxation can also be treated by the most invasive method of eminencetomy (Myrhaug's surgery), which is the most invasive method for the patient. This implies preoperative thorough diagnostics (CBCT). In general, the procedure can be performed not only under general anesthesia (most often) but also under local anesthesia. Surgical reduction of eminence will not prevent luxation but will allow spontaneous return of the condyle to the glenoid fossa during the closing of the mouth [26–28].

The complication of temporal bone surgery is a zygomatic air cell defect (ZACD) located posteriorly from the zygomatico-temporal suture in the zygomatic process of temporal bone such as air-containing structures – external auditory meatus and mastoid cells. ZACD should be previously excluded with CBCT (Figure 4a). Any surgical intervention with the opening of the pneumatic temporal bone space would lead to propagation of oral microflora infection [29, 30].

Evaluation of therapeutic modalities, whether non-invasive or surgical, is based on the degree of pain relief and comfort on mouth opening. The assumption is that better self-regulation of the patient during mouth opening will be at least partially effective in eliminating painful subluxation problems. In those patients who are non-surgically treated and in which subluxation still poses problems in mandibular movements, there is less potential for successful therapy. At that point, reducing the pain is a significant result. Surgical therapy is, however, too aggressive, hence both the patients and surgeons avoid it.

Conclusion

From the aforementioned, it is clear that the disorders that we classify in the TMD group are complex and sometimes multifactorial etiology and pathophysiology. Therefore, the procedures for accurate diagnosis of the disorder itself are complex because some individual diagnoses according to DC / TMD can overlap the same person at the same time. In addition

to the physical component, it is also necessary to evaluate the psychological state of the patient [31–33]. Kinematic joint recording is beneficial to documentation of disorders as well as to the process of assessing the condition for a longer period of follow-up [13,15].

Painless subluxation is often inconspicuous; hence such individuals do not seek help. Subluxation can be an incidental finding if TMJ x-ray diagnostics is performed within the hospital's treatment of patients due to other orofacial pains. Hyperextension is the most neutral radiologic description of a hypermobile condyle, and depending on the clinical condition, luxated condyle. The hypermobility (subluxation) of the condyle is not a consequence of the morphopathological condition, but reflects the variation of the anatomical shape of articular structures. Radiological modalities confirm the clinical finding but do not indicate why luxations or subluxations occur, whereas MRI is the most important method which confirms the condition of intraarticular structures in the case of disc disorder.

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