Temporomandibular joint osteoarthrosis and joint mobility

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SUMMARY

The temporomandibular joint (TMJ) is a synovial joint. Two bony joint partners are covered with articular cartilage. The joint is enclosed in a joint capsule. The joint capsule is lined with a synovial membrane, producing synovial fluid, which is of importance for lubrication and nutrition of the joint. The joint space is divided into two functional compartments by an articulating disc. Although the bony joint partners are covered with fibrocartilage, and not by hyaline cartilage as is the case in most other synovial joints, the TMJ functions as a synovial joint. Joint pathology as it occurs in other synovial joints, may also affect the TMJ in an identical way. Osteoarthrosis (OA) frequently affects the TMJ. OA is a degenerative joint disease primarily affecting articular cartilage. The etiology of OA is still unknown, but it is generally assumed that abnormal loading or mechanical overloading plays an important role. As etiologic factors for TMJ OA generalized joint hypermobility (GJH) and TMJ hypermobility have been considered. Studies investigating the relationship between TMJ OA and GJH give conflicting results. In most studies non-reliable assessment methods for GJH were used. However, if a relationship between GJH and TMJ OA exists, it is not clear what the exact causal relationship is. Is the TMJ also hypermobile in case of GJH and is the hypermobile TMJ mechanically overloaded or loaded abnormally, due to its laxity, resulting in TMJ OA? The relationship between TMJ mobility and mobility of peripheral joints has hardly been studied. The relationship between TMJ hypermobility and TMJ OA has not been studied yet but has often been suggested. Many different measures for TMJ (hyper)mobility are currently used according to literature. The most frequently used measure is linear mouth opening (LMO: maximal interincisal distance added to the vertical overlap of the dentition). LMO, however, is not only influenced by TMJ mobility, but it is also influenced by mandibular length (ML). Moreover, no general agreement exists as for which measure is the most appropriate one and when it should be used. Finally, the interrelationship between the different measures for TMJ mobility has hardly been investigated.

In **chapter 1** the aims of the investigation are described:

- to develop clinical methods for measuring joint mobility of selected peripheral joints whose mobility is assumed to represent mobility of other joints, and to determine the reliability of these measuring methods,
- to develop a clinical method for temporomandibular joint mobility measurement independent of mandibular length, and to determine its reliability,
- to analyse the interrelationship between different measuring methods for temporomandibular joint mobility,
- to analyse the relationship between temporomandibular joint osteoarthrosis and generalized joint hypermobility,
- to analyse the possible influence of condylar hypermobility on the occurrence of

temporomandibular joint osteoarthrosis,

- to analyse the general character of joint (hyper)mobility by comparing temporomandibular joint mobility and mobility of peripheral joints and trunk flexion.

In **chapter 2** a standardized joint mobility measuring method is proposed, and its reliability tested. The maximal ranges of motion of passive digit five hyperextension, passive thumb apposition to the volar aspect of the forearm, active elbow and knee hyperextension, active ankle dorsalflexion and trunk flexion were measured in 30 healthy subjects, 14 females and 16 males. All measurements were performed bilaterally, except trunk flexion. Of the joints mentioned it is assumed that their mobility reflects mobility of other joints. Three observers performed the measurements according to a rigidly standardized protocol, using goniometers and rulers. A test-retest procedure was applied. The results of the measurements were analyzed using ANOVA. The intra-observer variation as well as the inter-observer variation was least for elbows, knees, ankles and trunk flexion and was somewhat larger for digits five and thumbs. The passive nature of the measurement of the latter joints may be responsible for the larger variations. It appeared that our confidence limits for joint mobility measurements fell within the ranges of variation mentioned in literature. The joint mobility measuring method reveals a mobility score for each separate joint and provides a basis for comparison between individuals and between groups of individuals, both in case of single and generalized joint mobility assessment. Based on the results of this study it is concluded that joint mobility can be measured reliably and accurately with the help of the simple tools presented.

The maximal interincisal distance added to the vertical overlap (linear mouth opening, LMO) is generally used as a measure for TMJ mobility. However, ML influences LMO also. The angular displacement of the mandible relative to the cranium during maximal mouth opening (angle of mouth opening, AMO) is a measure for TMJ which is independent of the ML.

In **chapter 3** the measuring instruments and measuring protocol are described for measurement of AMO. The reliability of measuring protocol and goniometers were determined in a test-retest protocol. Ten subjects, 2 males and 8 females participated in this study. The results were analyzed with ANOVA. Intra-observer variability was found to be 2.0° when the results of all the measurements were analyzed and was found to be 1.2° when the mean value of the sessions was used for analysis. Based on the results of this study it can be concluded that AMO can be measured reliably. AMO is a suitable measure for TMJ mobility to be used in epidemiologic investigations or to be used when comparing TMJ mobility with mobility of other joints, because of its independence of ML.

TMJ mobility is assessed in different ways: measurement of LMO, AMO, assessment of the condylar position relative to the articular eminence assessed on transpharyngeal radiographs in maximal mouth opening, i.e. condylar mobility (CM). And further, measurement of angular displacement of the mandible at maximal mouth opening relative to the closed mouth position of the mandible, assessed on transpharyngeal radiographs, taken in maximally open and in closed mouth position (radiographic angle of mouth opening, RAMO).

In **chapter 4** the study is described in which the different TMJ mobility assessment methods are compared and in which the relationship between LMO, AMO and ML is analyzed. Twenty-eight healthy volunteers (13 females, 15 males), with a symmetrical mouth opening pattern, participated in the study. LMO, AMO, and ML were measured, and RAMO and CM were assessed on transpharyngeal radiographs. The results were analyzed using calculations of Pearson's and Spearman's r, a linear regression model, and paired t-testing. AMO was strongly and significantly related to LMO and to CM. LMO was significantly influenced by AMO and ML. CM was weakly but significantly related to LMO. No significant differences between AMO and RAMO were found. On the basis of the results of this study the following recommendations are made:

- LMO should be used clinically to evaluate TMJ function over time within one subject.
- AMO is the appropriate measure for TMJ mobility when comparing TMJ mobility between subjects.
- AMO is the appropriate measure for TMJ mobility, when comparing TMJ mobility with the mobility of other joints.
- CM is an appropriate measure for condylar slide capacity when transpharyngeal radiographs are available.

In **chapter 5** the possible relationship between TMJ OA and GJH is analyzed. Peripheral joint mobility and trunk flexion of 25 female TMJ OA patients and of 29 female controls were measured according to the measuring protocol described in chapter 2. The patients were selected on the basis of clinical and radiographical signs of OA and ID and on the basis of MRI examination. The measurement results were analyzed using uni- and multi-variate techniques. No significant differences were found between the two groups with regard to joint mobility. On the basis of the results of this study, it was concluded that there was no prevalence of GJH in the OA group, so most likely there is no relationship between GJH and TMJ OA.

In **chapter 6** the relationship between condylar hypermobility and TMJ OA is analyzed. Thirteen female patients with bilateral condylar hypermobility were evaluated clinically and radiographically, 30 years after non-surgical treatment. Three evaluation moments were used in this study; a pre-treatment evaluation, a post-treatment evaluation, and a recent evaluation. The evaluations included maximal interincisal distance, horizontal movements of the mandible, joint and muscle tenderness to palpation, joint sounds and masticatory function. Radiographs of the TMJs were evaluated for the absence or presence of degenerative changes. The evaluation results of the hypermobile group (HG) were analyzed over time and were compared with the results of an evaluation of a control group (CG)(n=13). The CG was evaluated in the same way as the HG. Statistics included t-tests, to compare ranges of motion in the HG over time and to compare ranges of motion between HG and CG. It included non-parametric tests to compare tenderness of muscles and joints, joint sounds, masticatory function, and radiographic changes over time in the HG. And finally the same variables between HG and CG group were compared. The maximal interincisal distance and the horizontal movements did not significantly change over time in the HG. Further, LMO and the horizontal movements were similar in both groups. Joint and muscle tenderness did not change significantly over time in the HG and did not differ significantly from joint and muscle tenderness present in the CG. The joints in the HG presented a significant decrease in reciprocal clicking over time. Masticatory function did not differ significantly between the groups. Radiographically, the number of joints in the HG presenting degenerative changes increased significantly over time and the number of joints in the HG presenting degenerative changes was significantly higher than those in CG. On the basis of these research results, only radiographic differences between the groups and no clinical or functional differences between the groups, it is concluded that TMJ hypermobility is a subsidiary factor in the development of TMJ OA.

In **chapter 7** the relationship between TMJ mobility and mobility of peripheral joints and the general character of peripheral joint mobility is studied. Eighty-three subjects, 55 females and 28 males, were recruited from the Department of Oral and Maxillofacial Surgery of Groningen. All participants were in good general health and did not present TMJ disorders, anamnestically, clinically or radiographically. Of these subjects, joint mobility according to the protocols described in the chapters 2 and 3 was measured. The results were analyzed using uni- and multi-variate techniques. A very weak relationship between TMJ mobility and mobility of the other joints was found. Multiple regression revealed that only 25.9% of the total variance of AMO could be explained by mobility of peripheral joints, age and sex. Correlations between mobility of the different joints were never stronger than 0.4, except for paired joints. Principal component analysis revealed a very weak general character of joint mobility, three factors explained only 55.6% of the total variance. It is concluded that TMJ mobility cannot be predicted on the basis of the mobility of other joints, nor can mobility of peripheral joints be predicted in that way. These findings raise serious questions as to the concept of GJH.

In **chapter 8**, the general discussion, the results of the different studies are discussed. The better points and some restrictions of the study are analyzed. In addition, the general character of joint mobility is discussed and the concept of GJH is analyzed. Suggestions for future research are given. Finally, it is concluded that the role of GJH and of hypermobility of the TMJ are of less importance than is generally assumed.