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Recognition, prevalence, and risk factors of internal derangements of the temporomandibular joint

Huddleston Slater, J.J.R.

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Chapter 10

Summary (Samenvatting)

An internal derangement (ID) of the temporomandibular joint (TMJ) is described as a deviation in position or form of the tissues within the capsule of the joint. Functionally, this deviation is manifest by interferences with smooth TMJ movements. **Chapter 2** briefly describes internal derangements that are associated with clicking, such as anterior or posterior disc displacements with reduction (ADD or PDD) within the TMJ, and hypermobility of the TM condyle. Although most internal derangements are considered harmless and cause no or only little discomfort to the patients, it is believed that anterior or posterior disc displacements with reduction may occasionally develop into a more serious clinical condition; a closed lock or open lock (Blankestijn and Boering, 1985; Okeson, 1996). Unfortunately, it is unknown which disc displacements show this development, and under which conditions, because so far, studies to internal derangements have mainly been concentrated on the "TMJ clicking" phenomenon as such and not on the underlying causes. To gain more insight into the possible long term clinical implications of internal derangements, research should focus on their prevalence rates and risk factors rather than on those of symptoms such as clicking. Large population samples are then needed and one is, for practical reasons, limited to clinical examination techniques. The aim of this thesis was therefore threefold. The first aim was to propose sets of clinical criteria for the recognition of types of internal derangements, and to test their reliability and validity. The second aim was to study the prevalence of types of internal derangements in children and adults. The third aim was to study risk factors for different types of internal derangements.

Criteria for the clinical detection of ADDs have been described in the Research Diagnostic Criteria (RDC) for Temporomandibular Disorders (Dworkin and LeResche, 1992). The amount of mouth opening at the time of the opening and closing click plays an important role in the recognition of an ADD. However, the clinical experience that the closing click is often of less magnitude than the opening click (McNeill, 1993), may hinder the recognition of IDs. In **chapter 3**, the compression in the TMJ during opening and closing movements was studied. The hypothesis was tested that the difference between opening and closing movement traces of the kinematic center is reduced when the closing movements are counteracted by a mechanical load. From 10 healthy participants, 20-second movement recordings were obtained by a six degrees of freedom opto-electronic jaw movement recording system (OKAS-3D) for three types of movements: (1) free opening and closing movements, (2) free opening and loaded closing movements (i.e., the participants closed against a small or high manually applied downward-directed force to the chin), and (3) gum chewing. Off-line, the opening and closing movement traces of the kinematic cen-

ter were reconstructed, and the average difference between the traces (the intra-articular distance) was calculated. The average intra-articular distance was significantly smaller during loaded closing than during free closing, whereas no significant differences were found in the intra-articular distances between the loaded situations of low and high manual loading and contralateral chewing. It was concluded that the compression in the TMJ was smaller on closing than on opening. This may explain why the opening click is usually louder than the closing click and why the closing click can further be provoked by closing the mandible against a counteracting force.

According to the Research Diagnostic Criteria (Dworkin and LeResche, 1992) an anterior disc displacement with reduction (ADD) is characterized by reciprocal clicking, the opening click occurring at a mouth opening at least 5 mm greater than that of the closing click. Why a difference in interincisal distance of at least 5 mm is considered characteristic for an ADD is not substantiated in the RDC. Therefore, in **chapter 4** it was tested whether this 5 mm criterion is characteristic for an ADD. From 30 participants with a unilateral ADD, six degrees of freedom movement recordings together with joint sound recordings were made. The participants performed free open movements and loaded closing movements. In 8 joints (27%), the 5 mm criterion was not fulfilled. For two participants, the click on closing occurred at an even larger mouth opening than that on opening. Recordings of the condylar movements showed, that the opening clicks occurred in a broad range of the opening movement, whereas all the closing clicks occurred just before the condyle reached its terminal position in the fossa. It was concluded that the 5 mm criterion of the RDC is not very characteristic for anterior disc displacements with reduction.

In the previous chapters, the RDC-criteria for ADD were studied and the results suggest that the RDC-criteria for the detection of an ADD should be adjusted. However, to recognize other internal derangements as well, additional criteria need to be developed and tested. The aim of **chapter 5** was to examine the concurrent validity of clinical criteria, as suggested in this study, for the recognition of various types of internal derangements within the temporomandibular joint (TMJ). The results of the clinical examination were compared with those of condylar movement recordings and MR imaging. To test the recognition of an anterior or posterior disc displacement with reduction and of hypermobility within the TMJ, forty-two participants underwent a clinical examination, an opto-electronic movement recording and a MRI scan. The examinations were executed in a single blind design, by different examiners for each technique. For 10 randomly chosen participants, the condylar movement recordings and the MRI's were recorded twice. The data of these

second recordings were added to the other data, while the examiners were unaware of their presence. The intra-observer reliability for the recognition of internal derangements was "almost perfect" for the condylar movement recordings (Kappa value $K=0.86$) and for the MRI's ($K=0.73$). The inter-method reliability was substantial ($K=0.59$) between the two function-based techniques, i.e. between the clinical examination and the condylar movement recordings. However, the inter-method reliability was poor between the anatomy-based MRI technique and either of the two function-based techniques (for the condylar movement recordings, $K=0.15$ and for the clinical examination, $K=0.12$). Conclusion: for the achievement of a function-based diagnosis of an internal derangement, a clinical examination, which is based upon clearly defined sets of criteria, is sufficient.

For the clinical use of the proposed sets of criteria, not only their validity needs to be tested, but also their reliability. The inter-observer reliability of the clinical recognition of internal derangements by means auscultation, palpation or both was tested in **chapter 6**. To that end, 120 women and 100 men were screened by two trained examiners for the presence of internal derangements. Anterior disc displacement was diagnosed in 14% of the cases and hypermobility in 12%. In 4% of the cases, the internal derangement was classified as "other". The inter-rater reliability ($K = 0.58$) was moderate for the presence of an internal derangement as such, while for the classification into type, an almost perfect reliability was found for the combined technique ($K = 0.90$). It was concluded that the type of internal derangement can best be established with the combination of auscultation and palpation; for the establishment of the presence of an ID as such, any of the three techniques would suffice.

With the use of the developed and validated criteria, **chapter 7** assessed the prevalence and risk factors of types of internal derangements. Using validated clinical criteria, 1835 children and 320 adults were examined for the presence of anterior disc displacement with reduction (ADD) and hypermobility, and possible risk factors were documented. Both types of IDs had about an equal prevalence: 52% of the children with an ID had an ADD and 45% had hypermobility. For the development of ADDs within the children group, the most important risk factor was increasing age during childhood and adolescence. It has been suggested that the development of an ADD is related with various anatomical relations between components of the TMJ (Pullinger *et al.*, 2002). In line with this suggestion and the finding that the closing click always occurs just before the condyle re-enters the fossa, an ADD may be the result of a space insufficiency within the joint, so that the condyle and disc cannot be jointly accommodated in the fossa. As a compromise, the disc then gets

anteriorly displaced. The fact that the found risk factors for ADD, are mostly related with growth and bodily development, corroborates the suggestion that a space insufficiency is involved in the etiology of ADDs indeed. The finding that in girls, who tend to mature earlier than boys, ADDs develop earlier, makes this suggestion even stronger. For hypermobility, the most important risk factors were associated with an increased flexibility of the joint, viz., amount of mouth opening, female gender, and non-Caucasian race.

Due to the rarity of posterior disc displacements, it was impossible to study their prevalence and risk factors. In **chapter 8** however, a case report was presented about a patient with an acute posterior disc displacement without reduction (PDDWR), whose temporomandibular joint (TMJ) showed, after manipulation, the characteristics of a posterior disc displacement with reduction (PDDR). Caudal traction and dorsal compression techniques were used to reduce the disc; condylar movement recordings of the joint in both the PDDR state and the PDDWR state, and MRI's of the TMJ in the PDDR state were made to document the case. The first two manipulations were initially successful in reducing the disc, but a few days later the joint showed a relapse to the PDDWR state. From the third manipulation on, now 12 months ago, the patient is free of symptoms. Condylar movement traces of the joint in the PDDWR state indicated that the condyle was prevented from (completely) entering the fossa. The downward condylar movement deflections during the early phase of closing, recorded after the second manipulation, showed the reduction of the posteriorly displaced disc during closing. The movement recordings also showed that the PDDR's could be eliminated by submaximal opening and closing movements. The MRI's, taken after the third, successful manipulation, showed the disc to be in a normal position with respect to the condyle when the mouth was closed, and to be posteriorly displaced when the mouth was maximally opened. It was concluded that manipulation techniques can successfully reverse an acute PDDWR into a PDDR. The techniques of MRI's and condylar movement recordings look promising in further unraveling the morphological and clinical features of posterior disc displacements.

Conclusions

- The results of this thesis stress the importance to discriminate types of internal derangements
- The prevalence of anterior disc displacement and hypermobility is about equal (14% vs. 12%)
- Risk factors for the development of an ADD are growth and bodily development, and not ageing of the joint
- Hypermobility is associated with a higher flexibility of the joint.
- Although a posterior disc displacement is rare, it may be a serious clinical problem for the patient.