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### Temporomandibular joint internal derangements: Diagnosis, mechanisms and risk factors, and prognosis

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## **Chapter 8**

### **Summary**



The temporomandibular joint (TMJ) is one of the most complex articulations in the human body. The structure of the temporomandibular joint allows performing complex movements with a high degree of freedom. Smooth mandibular motion, however, can be hampered by the presence of so-called TMJ internal derangements (IDs). An ID of the TMJ is, from an anatomical point of view, defined as a deviation in position or form of the intra-articular tissues. Clinically, an ID is only manifested when it interferes with normal, smooth mandibular movements. In several chapters of this thesis, aspects of the diagnosis, mechanisms and risk factors, and natural course of two of the most common types of IDs, viz., symptomatic TMJ hypermobility and anterior disc displacement with reduction (ADDR) are studied. The aim of the thesis is three-fold: (1) to evaluate the current clinical criteria for the recognition of an ADDR (**Chapter 2**); (2) to study the mechanisms and risk factors for symptomatic TMJ hypermobility, ADDR, and the loss of disc reduction (**Chapters 3, 4 and 5**); and (3) to study the natural course of ADDR (**Chapter 6**).

In the first paper within this thesis (**Chapter 2**), the current Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) for the recognition of an anterior disc displacement with reduction are considered, and consequently revised clinical criteria are proposed. The evaluation is based upon the experience gained through the careful analysis of mandibular movement recordings of hundreds of patients and controls with or without an ADDR. Clinically, it is a challenge to discriminate between ADDR and symptomatic TMJ hypermobility, as those are the two most prevalent types of IDs. It is due to the very nature of these derangements that they both show clicking on opening and closing (reciprocal clicking), making reciprocal clicking not a distinguishing feature between these disorders. However, there is a difference in timing of their opening and closing clicks. Unfortunately, it is not feasible to clinically use this difference in timing to distinguish between the two internal derangements, because it is the amount of mouth opening at the time of the clicking which can clinically be noted, not the condylar translation. Two other criteria proposed by the RDC/TMD for the recognition of an ADDR (the 5-mm difference in mouth opening at the time of the opening and closing clicks, and the detection of joint sounds on protrusion or laterotrusion in case of non-reciprocal clicking), run the risk of false positive or negative results and have therefore no great diagnostic value. Instead, it is recommended to examine the reciprocal nature of clicking, and to test the elimination of clicking on protrusive opening and closing in order to distinguish ADDRs from symptomatic TMJ hypermobility. In case of doubt about the presence of clicking on opening, or closing, clicking should be examined by loading the TMJ on movement through the application of a light counter pressure on the patient's chin.

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TMJ hypermobility is clinically noted only when it interferes with smooth mandibular movements. These interferences (viz., clicking joint sounds and jerky mandibular movements) result from condylar displacement in front of the eminence at wide mouth opening. In the second study of this thesis (**Chapter 3**), the proposed mechanism for the symptoms of hypermobility was studied and the hypothesis was tested that condyles of hypermobile persons are positioned more anterosuperiorly to the crest of the eminence during maximum mouth opening than those of persons without symptomatic TMJ hypermobility. Nine persons with symptomatic TMJ hypermobility and nine control subjects free of IDs were included, their diagnoses being based upon opto-electronic movement recordings. Condylar positions during maximum mouth opening were analyzed on magnetic resonance images with two slightly different methods, showing the degree to which the condyles are displaced beyond the eminence. After excluding one outlier and using both measurement methods, a small difference in condylar position was found between the two groups of subjects. The condyles of all hypermobile persons travelled beyond the eminence; however, so were the condyles of nearly half of the non-hypermobiles. The large overlap between both groups suggests that condylar position alone is not a good predictor for symptomatic TMJ hypermobility. It is probably the combination of condylar location in front of the eminence with a particular line of action of the masticatory muscles, which gives rise to functional signs of hypermobility.

Patients with ADDR sometimes report sudden, transient mouth-opening limitations (intermittent locking). While oral parafunctions, symptomatic TMJ hypermobility and an increasing age, especially in adolescence, are suspected as ADDR risk factors, those for the loss of disc reduction in intermittent locking are unknown. In the third study (**Chapter 4**), the hypothesis was tested in adolescents parafunctions and symptomatic TMJ hypermobility are risk factors for both ADDR and intermittent locking. For this purpose, 260, twelve to sixteen year-old adolescents (52% female), visiting a university clinic for regular dental care, participated. ADDR and symptomatic TMJ hypermobility were diagnosed using a structured clinical examination. During the anamnesis, reports of intermittent locking and of several parafunctions were noted, viz., nocturnal tooth-grinding, diurnal jaw-clenching, gum-chewing, nail-biting, lip- and/or cheek-biting, and biting on objects. The adolescents' dentitions were examined for opposing matching tooth-wear facets as signs of tooth-grinding. Risk factors for ADDR and intermittent locking were first assessed using univariate logistic regression, and then entered into a stepwise backward multiple model. While in the multiple model, ADDR was associated only with increasing age ( $P = .02$ , explained variance 8.1%), intermittent locking

was weakly correlated to diurnal jaw-clenching ( $P = .05$ , explained variance 27.3%). In adolescence, diurnal clenching seems to be a risk factor for intermittent locking, while age for ADDR. Symptomatic TMJ hypermobility seems to be unrelated to either ADDR, or to intermittent locking.

The aim of the fourth study (**Chapter 5**) was to test whether TMJ loading by means of an intensive chewing exercise would influence the moment of disc reduction in subjects with or without reports of intermittent locking. In this experimental study, 15 subjects with an ADDR with symptoms of intermittent locking, and 15 subjects with an ADDR without such symptoms participated. The moment of disc reduction (MDR), quantified using mandibular movement recordings, was recorded at baseline, after maximally 60 minutes of chewing, after 20 minutes of rest, and, if necessary, after 72 hours. In subjects without intermittent locking, the MDR after chewing was not different from baseline ( $P = .25$ ). However, in subjects with intermittent locking, the MDR value had increased significantly after chewing ( $P = .008$ ); two subjects showed a later moment of disc reduction, while four showed a temporary loss of disc reduction. This indicates that while intensive chewing does not influence the disc reduction in subjects without intermittent locking, it can cause a temporary delay, or temporarily hamper disc reduction in subjects reporting intermittent locking.

Joint clicking in ADDR may disappear over time, mostly in subjects reporting intermittent locking. The aim of the fifth study (**Chapter 6**) was to test whether the disappearance of clicking is related to a gradual loss of reducing capacity of the disc, or to an intra-articular restoration of disc position in time. Twenty-five ADDR subjects without, and 30 ADDR subjects with reports of intermittent locking participated in this two-year follow-up study. Clinical examinations and mandibular movement recordings were performed at baseline, and after one and two years. If mandibular movement recordings showed no longer signs of an ADDR, magnetic resonance images were taken. Mandibular movement recordings showed MDR to be stable over the observation period in the group of subjects without intermittent locking ( $P = .95$ ). In the group of subjects with intermittent locking, MDR had shifted to a later mouth opening ( $P = .000$ ). At the individual level, in 7 of these subjects, clicking had totally disappeared, usually without symptoms of permanent locking. On the magnetic resonance images of these subjects, the disc displacement was still present, but with no, or only a partial reduction. In conclusion, intermittent locking may be indicative for a coming permanent loss of reducing capacity of the disc. This loss is only rarely accompanied by symptoms of a closed lock.

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## Conclusions

- The following clinical protocol to recognize ADDRs is recommended: (1) Examine the reciprocal nature of the TMJ clicking; (2) In case of doubt about the presence of clicking on opening or closing, lightly load the TMJ on movement through the application of counter pressure to the patient's chin; (3) Examine the elimination of clicking on protrusive opening and closing in order to distinguish ADDRs from symptomatic hypermobility.
- Condylar position alone is not a good predictor for symptomatic TMJ hypermobility. It is probably the combination of condylar location in front of the eminence with a particular line of action of the masticatory muscles, which gives rise to functional signs of hypermobility.
- ADDR is related to an increasing age in adolescence, indicating that ADDR may arise from the intra-articular developmental changes in that period. Symptomatic TMJ hypermobility and oral parafunctions seem to be unrelated to ADDR development.
- Loading upon the TMJ, for example, by means of oral parafunctions, may contribute to the loss of TMJ-reducing capacity in subjects reporting periods of intermittent locking, but not in subjects without such symptoms.
- Symptoms of intermittent locking may be indicative for a coming permanent loss of reducing capacity of the disc. This permanent loss is only rarely accompanied by symptoms of a closed lock.
- ADDRs with symptoms of intermittent locking should be considered a separate and clinically relevant entity within the group of TMJ disc displacements.