Correlation between Steepness of Articular Eminence and Progressive Internal Derangement of Temporomandibular Joint

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The purpose of our research was to verify the hypothesis that flat articular eminence is the result of progressive internal derangement (ID) of the temporomandibular joint (TMJ). 614 joints were classified into five diagnostic groups (stages of ID). The assessment of TMJ internal derangement was based on the sagittal plane magnetic resonance images (MRI). The steepness of articular eminence was determined by computerized axiography. The results of the study could not identify any correlation between steepness of articular eminence and progressive internal derangement of the temporomandibular joint. These data suggest that any change of articular eminence steepness induced by remodelling or degenerative changes secondary to ID is not essential.

Key words: temporomandibular joint, magnetic resonance imaging, temporomandibular joint disk

INTRODUCTION

Many articles have been published about the possible relationship between the morphology of the upper component of the TMJ (the mandibular fossa and articular eminence) and temporomandibular joint disorders (TMJD), signs and symptoms related to TMJ dysfunction and internal derangements (1–13). Some researchers have suggested that the anatomy of articular eminence may predispose to disk displacement (1–4), while others have proposed that disk displacement may lead to changes in its shape (4–8). The inclination of the condyle path during mandibular movement was reported to be steeper in TMJs with signs of disk displacement (2, 3, 9, 10). No significant correlation between the degree of disk displacement with or without reduction was confirmed. In contrast to this, some studies (6–8, 11, 12) have shown that the steepness of articular eminence in TMJs with permanent disk displacements was less prominent than in those with reducible displaced disks. Reduction or flattening in the posterior slope of the articular eminence has been found in autopsy specimens and said to be the result of arthrosis (5). In an attempt to examine the possible relationship between the horizontal condyle inclination (HKN) angle and the degree of “internal derangement”, we tested the hypothesis that flat articular eminence is the result of progressive internal derangement of the TMJ.

MATERIALS AND METHODS

In the population-based representative cross-sectional Study of Health in Pomerania (SHIP) there were 307 subjects (140 males and 167 females) selected for this investigation. The age of the subjects ranged from 20 to 54 years mean 35.4.

According to the clinical diagnosis of SHIP, 114 subjects had at least one sign of temporomandibular disorders (tenderness/pain on palpation of the joints or muscles, TMJ sounds, pain or deviation during maximum mouth opening (active/passive). 193 subjects served as controls. All subjects underwent computerized axiography and MRI after a proper history taking and assessment of clinical symptoms. The axiographic and MRI results were independently assessed by two experienced diagnosticians.

The registration of TMJ tracings was made with the conventional double face-bow Cadiax III-System (Gamma, Wien). A three-dimensionally adjustable lower bow was used to transmit the hinge-axis movement of the mandible to the upper face bow (Fig. 1).
MRI was performed with 1.0 Tesla scanner (Magnetom Impact Expert, Siemens, Germany) using a bilateral TMJ surface coil 7 cm in diameter. The imagines were performed with the following Spin-Echo-Sequent Parameters:

- axial (Scout image) - T1 weighed images, TR = 140, TE = 15, Flip 90;
- sagittal - T1 weighed images. Nine images with 3 mm thick slices; TR = 448 ms, TE = 15, Flip = 90, M atrix% 75 (192*256);
- coronal - T1 weighed images, TR = 450, TE = 15, Flip = 90, M atrix% 75 (192*256).

Three (lateral, central und medial), 3 mm ortho-
gonal sagittal images of the TMJ were obtained with the jaw in the maximal intercuspal position (MIP) and then at maximal opening.

The position and shape of the articular disk was determined in both cases when the mouth was closed and when it was open. It was possible to distin-
guish the normal, dumbbell-like configuration of the disk (Fig. 2), from pathologic changes, such as string-shaped, wedge-shaped, folded, or lamellar images.

The physiological position of the disk was considered from two points of view:

- the pars intermedia of the disk has to lie in the area of the shortest distance between the anterior cranial outline of the condyle and Protuberantia arti-
cularis (13);
- the junction line between the middle point of the condyle and the posterior margin of the disk must not be more than 10° from the 12 o’clock position (14) (Fig. 2).

Any forward displacement of the disk constituted anterior displacement. A displaced disk was further categorized according to Bumann and Lotzmann (13) as partially and completely displaced with a partial or complete reduction depending on the relation-
ship with the condyle in an open-mouth position. However, if the complete displaced disk remained in an anterior position relative to the condyle in an open-mouth position, it was classified as complete disk displacement without reduction.

Osseous changes were determined from the sha-
pe of the condylar head, which might have lost its round shape and developed a flattened, oval surfa-
ce. A regular spongiosa signal was distinguished from a hypo-intensive signal, and the existence of osteo-
phytes could also be determined.

All joints were subsequently classified into five diagnostic groups (modified stages of ID according to Wilkes (15) and Schellhas (16)):

- physiological disk position (PPD) without chan-
ges in the morphology of the disk and/or condyle;
- partial disk displacement with complete repo-
sition (part. DDCR), without changes in the mor-
phology of the disk and/or condyle;
- partial or complete disk displacement with com-
plete reposition (part. or compl. DDCR), with changes in the morphol-
y of the disk and/or condyle;
- partially or complete disk displacement with partial reposition (part. or compl. DDPR), with changes in the morphology of the disk and/or condyle;
- complete disk displacement without reposition (compl. DDWR) with changes in the morphology of the disk and/or condyle.

Differences in the distribution were analysed by the Chi-square ($\chi^2$) test. $P < 0.05$ was considered significant.

RESULTS

Figures 3–5 demonstrate the absolute frequentness of MRI sagittal plane findings for the right and left TMJ.

Figure 6 shows a correlation between the hori-
zontal condyle inclination (HKN) angle and the sta-
ges of internal derangement of the TMJ.

Figure 6 also demonstrates that there was no significant dependency between the horizontal con-
dyle inclination (HKN) angle and the degree of “in-
ternal derangement” ($\chi^2$-test, $P > 0.05$).
No correlation could be found between the age and the HKN angle values, either (p > 0.05 and R < 0.10).

DISCUSSION

The results of the present study corresponding to the investigations of Hugger et al. (17) and Kordaß (18) do not support the hypothesis that the steepness of the articular eminence is related to progressive ID. Most of the early studies used only clinical examination to make a TMJ diagnosis, so no objective information about the position of the disk was studied. A histological study has demonstrated that the bony outlines seen on radiographs may not accurately reflect the actual articular surface (19). The results of numerous comparative studies have indicated that clinical or radiographic examination alone is not sufficiently accurate to determine the anatomical background of TMJ dysfunction, especially when locking is the major symptom (20, 21). In this study, we employed MRI to assess the condyle and disc positions. MR imaging can produce high quality tomographic images with a great soft tissue contrast, without the need for ionizing radiation, anaesthesia or the injection of contrast agents (20, 21). This method is considered overall as the gold standard for a thorough assessment of the internal derangement of the TMJ (22, 23).

The inclination of the condyle path, measured with a face bow jaw tracking instrument, has been reported to be correlated with the steepness of the eminence as measured in later cephalograms (24). As axiography provides a three-dimensional coordinate system, it allows the measurement of the horizontal condyle inclination in relation to the axis-orbital plane. There is no such reference system in MRT, making it more difficult to assess the steepness of the articular eminence (25). Therefore the jaw-tracking device with a face bow system can be regarded as a reliable method of measuring the actual steepness of the articular eminence.

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References


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Santrauka


Raktapodžiai: smilkininis apatinio Šandikaulio sânarios, magnetinio rezonanso tomografinë, smilkininio apatinio Šandikaulio sânario diskas