ACTA MEDICA LITUANICA. 2004. VOLUME 11. No. 1. P. 13–16

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

Giedrë Kobs[1], Olaf Bernhardt[2], Georg Meyer[2]

[1] *Department of Prosthetic Dentistry, Institute of Stomatology, Vilnius University, Vilnius, Lithuania*
[2] *Department of Restorative Dentistry, Periodontology and Pediatric Dentistry, School of Dentistry, University of Greifswald, Germany*

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 (TMD), 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.

Correspondence to: Giedrë Kobs, Institute of Stomatology, Vilnius University, Þalgirio 115, LT-01100 Vilnius, Lithuania. E-mail: kobs@b4net.lt

MATERIALS AND METHODS

In the population-based representative cross-sectional Study of Health in Pomerania (SHIP) there were 307 subjects (140 males und 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).

Fig. 1. Computerized axiography adjusted to the head of patient

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, Matrix% 75 (192*256);

• coronal – T1 weighed images, TR = 450, TE = = 15, Flip = 90, Matrix% 75 (192*256).

Three (lateral, central und medial), 3 mm orthogonal 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 distinguish 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 articularis (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).

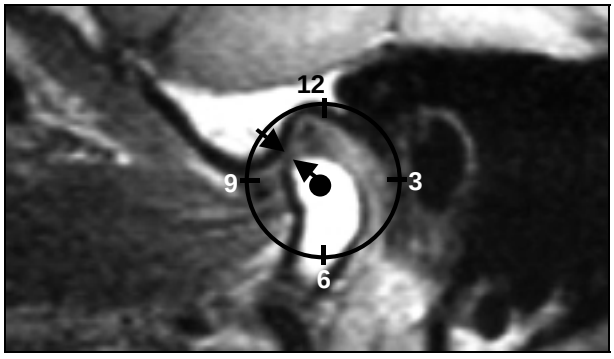

Fig. 2. Physiological position of disk

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 relationship 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 shape of the condylar head, which might have lost its round shape and developed a flattened, oval surface. A regular spongiosa signal was distinguished from a hypo-intensive signal, and the existence of osteophytes 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 changes in the morphology of the disk and/or condyle;

• partial disk displacement with complete reposition (part. DDCR), without changes in the morphology of the disk and/or condyle;

• partial or complete disk displacement with complete reposition (part. or compl. DDCR), with changes in the morphology 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 (χ^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 horizontal condyle inclination (HKN) angle and the stages of internal derangement of the TMJ.

Figure 6 also demonstrates that there was no significant dependency between the horizontal condyle inclination (HKN) angle and the degree of "internal derangement" (χ^2-test, $P > 0.05$).

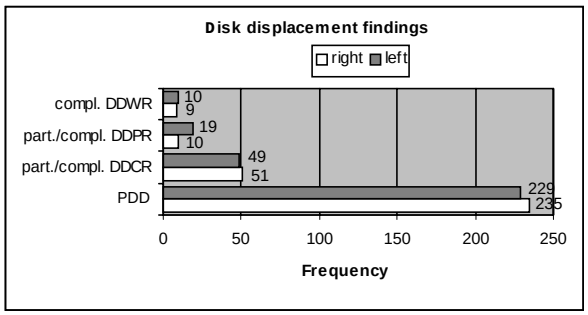

Fig. 3. Presentation of disk displacement findings on MRI

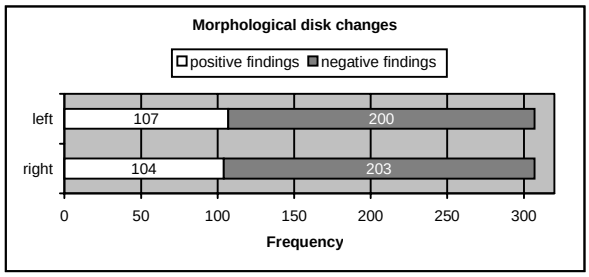

Fig. 4. Presentation of disk deformation findings on MRI

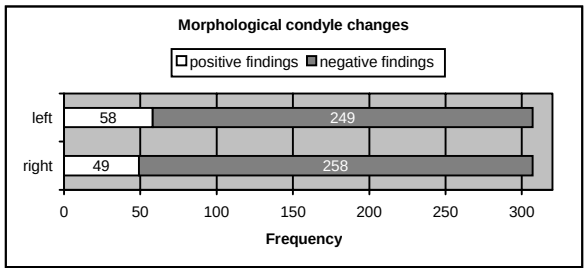

Fig. 5. Presentation of condyle deformation findings on MRI

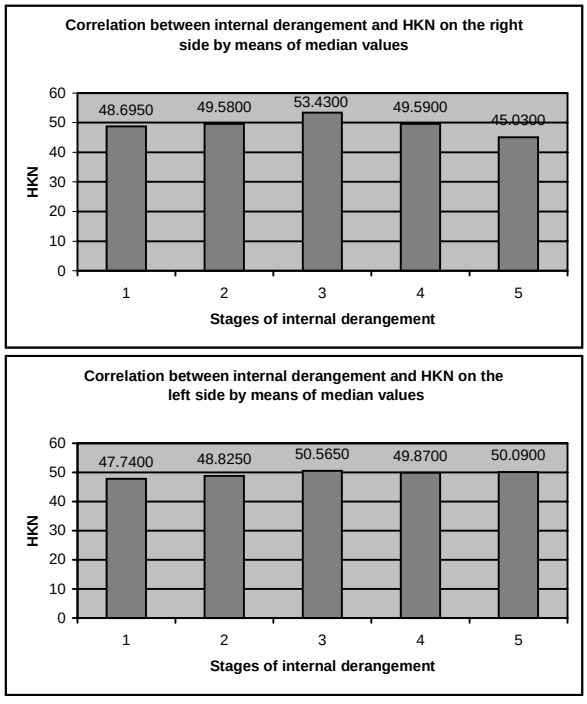

Fig. 6. Correlation between horizontal condyle inclination (HKN) angle and degree of internal derangement

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.

Received 2 September 2003
Accepted 28 November 2003

References

1. Atkinson WB, Bates RE. The effects of the angle of the articular eminence on anterior disk displacement. J Prosthet Dent 1983; 49(4): 554–5.
2. Hall MB, Brown RW, Sclar AG. Anatomy of the TMJ articular eminence before and after surgical reduction. J Craniomandib Pract 1984; 2: 135–40.
3. Hall MB, Gibbs CC, Sclar AG. Association between the prominence of the articular eminence and displaced TMJ disks. J Craniomandib Pract 1985; 3: 237–9.

4. Sato S, Kawamura H, Motegi K, Takahashi K. Morphology of the mandibular fossa and the articular eminence in temporomandibular joints with anterior disk displacement. J Oral Maxillofac Surg 1996; 25: 236–8.
5. Moffett BC, Johnson LC, McCabe JB, Askew HC. Articular remodelling in the adult temporomandibular joint. Am J Anat 1964; 115: 119–42.
6. Panmekiate S, Petersson A, Akerman S. Angulation and prominence of the posterior slope of the eminence of the temporomandibular joint in relation to disk position. Dentomaxillofac Radiol 1991; 20(4): 205–8.
7. Ren YF, Isberg A, Westesson PL. Steepness of the articular eminence in the temporomandibular joint. Tomographic comparison between asymptomatic volunteers with normal disk position and patients with disk displacement. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1995; 80: 258–66.
8. Toyama M, Kurita K, Westesson PL, Sakuma S, Ariji E, Rivera R. Decreased disk-eminence ratio is associated with advanced stages of temporomandibular joint internal derangement. Dentomaxillofac Radiol 1999; 28(5): 301–4.
9. Kerstens HC, Tuinzing DB, Golding RP, Van der Kwast WA. Inclination of the temporomandibular joint eminence and anterior disc displacement. J Oral Maxillofac Surg 1989; 18(4): 228–32.
10. Kerstens HC, Tuinzing DB, Van der Kwast WA. Eminectomy and discoplasty for correction of the displaced temporomandibular joint disc. J Oral Maxillofac Surg 1989; 47: 150–4.
11. Kurita H, Ohtsuka A, Kobayashi H, Kurashina K. Flattening of the articular eminence correlates with progressive internal derangement of the temporomandibular joint. Dentomaxillofac Radiol 2000a; 29(5): 277–9.
12. Kurita H, Ohtsuka A, Kobayashi H, Kurashina K. Is the morphology of the temporal component of the temporomandibular joint a predisposing factor for disk displacement? Dentomaxillofac Radiol 2000b; 29: 159–62.
13. Bumann A, Lotzmann U. Funktionsdiagnostik und Therapieprinzipien. In: Rateitschak KH, Wolf HF. (Hrsg): Farbatlanten der Zahnmedizin Bd. 12, Thieme-Verlag, Stuttgart 2000.
14. Drace JE, Enzmann DR. Defining the normal temporomandibular joint: closed-, partially open-, and open-mouth MR imaging of asymptomatic subjects. Radiology 1990; 177(1): 67–72.
15. Wilkes CH. Internal derangements of the temporomandibular joint. Pathological variations. Arch Otolaryngol Head Neck Surg 1989: 115(4): 469–77.
16. Schellhas KP. Internal derangement of the temporomandibular joint: radiologic staging with clinical, surgical, and pathologic correlation. Magn Reson Imaging 1989; 7(5): 495–515.
17. Hugger A, Kordaß B, Assheuer J, Stüttgen U. Zur Auswertung sagittaler Kernspintomogramme des Kiefergelenkes. Dtsch Zahnärztl Z 1993; 48: 37–44.
18. Kordaß B. Koppelung der Kernspintomographie des Kiefergelenks mit computergestützten Aufzeichnungen der Kondylenbahn. Habilitationsschrift, Düsseldorf 1993.
19. Pullinger AG, Bibb CA, Ding X, Baldioceda F. Contour mapping of the TMJ temporal component and the relationship to articular soft tissue thickness and disk displacement. Oral Surg Oral Med Oral Pathol 1993; 76: 636–46.
20. Paesani D, Westesson PL, Hatala MP, Tallents RH, Brooks SL. Accuracy of clinical diagnosis for TMJ internal derangement and arthrosis. Oral Surg Oral Med Oral Pathol 1992; 73(3): 360–3.
21. Ozawa S, Boering G, Kawata T, Tanimoto K, Tanne K. Reconsideration of the TMJ condylar position during internal derangement: comparison between condylar position on tomogram and degree of disk displacement on MRI. Cranio 1999; 17(2): 93–100.
22. Emshoff R, Brandlmaier I, Bertram S, Rudisch A. Comparing methods for diagnosing temporomandibular joint disk displacement without reduction. J Am Dent Assoc 2002; 133(4): 442–541.
23. Okeson JP. Management of temporomandibular disorders and occlusion. Mosby, St Luis 2003.
24. Corbett NE, DeVincenzo JP, Huffer RA, Shryock EF. The relation of the condylar path to the articular eminence in mandibular protrusion. Angle Orthod 1971; 41: 286–92.
25. Piehslinger E, Schimmerl S, Celar A, Crowley C, Imhof H. Comparison of magnetic resonance tomography with computerized axiography in diagnosis of temporomandibular joint disorders. J Oral Maxillofac Surg 1995; 24(1): 13–9.

G. Kobs, O. Bernhardt, G. Meyer

SÀNARINIO GUMBURËLIO ÐLAITO NUOÞULNUMO IR PROGRESYVAUS SMILKININIO APATINIO ÞANDIKAULIO SÀNARIO PAÞEIDIMO TARPUSAVIO PRIKLAUSOMYBË

S a n t r a u k a

Ðio darbo tikslas – nustatyti, ar plokðèias sànarinio gumburëlio ðlaitas yra progresyvaus smilkininio apatinio þandikaulio sànario paþeidimo rezultatas. 614 smilkininio apatinio þandikaulio sànariø buvo suskirstyta á penkias diagnostines grupes (pagal vidinio sànario paþeidimo stadijas). Smilkininio apatinio þandikaulio sànario paþeidimas ávertintas remiantis magnetinio rezonanso tomografija. Sànarinio gumburëlio ðlaito nuoþulnumas buvo nustatytas instrumentinio sànario judesiø uþraðymo (achsiografijos) bûdu. Ðio tyrimo rezultatai nepatvirtino statistinës priklausomybës tarp sànarinio gumburëlio ðlaito nuoþulnumo ir progresyvaus smilkininio apatinio þandikaulio sànario paþeidimo stadijos. Taigi galima teigti, jog bet koks sànarinio gumburëlio ðlaito nuoþulnumo pokytis, kaip antrinë smilkininio apatinio þandikaulio sànario paþeidimo pasekmë yra neesminis.

Raktaþodþiai: smilkininis apatinio þandikaulio sànarys, magnetinio rezonanso tomografija, smilkininio apatinio þandikaulio sànario diskas