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Department of Prosthetic Dentistry, Subdepartment of Craniomandibular Dysfunctions
1st Department of Radiology
Department of Human Anatomy, Medical University of Lublin

ANNA SZABELSKA, GRZEGORZ J. STAŚKIEWICZ,
ELŻBIETA CZEKAJSKA-CHEHAB, MACIEJ MAZGAJ, KAMIL TORRES,
JANUSZ KLEINROK, ANDRZEJ DROP, RYSZARD MACIEJEWSKI

# *Age-related changes and sex dependent differences of dimensions of temporomandibular joint in multislice computed tomography in asymptomatic subjects*

Multislice computed tomography (MSCT) is a recognized imaging modality in patients with temporomandibular joint (TMJ) pathologies. It allows proper visualisation of bone component of TMJ as well as surrounding structures, which in some cases may produce problems in evaluation of TMJ (4).

The aim of the study was to evaluate gender differences in measurements of TMJ structures in male and female asymptomatic population, as well as to establish age-related changes of these parameters in asymptomatic population.

## MATERIAL AND METHODS

150 examinations of patients (72 male and 78 female) of mean age 46.7 ± 17.5 ys (range 17–75) were studied retrospectively. In all subjects the CT examination was performed for TMJ - unrelated reasons which made inclusion of temporomandibular joints necessary. All the ents included into the study presented no symptoms related to dysfunction of TMJ. The CT examinations were performed in centric occlusion, using 8-row LightSpeed Ultra scanner (GE Medical Systems) with 120 kV and 160 mA. In each examination 1 m thick axial slices were obtained. Original scans were postprocessed by means of multiplanar reformations with dedicated Advantage Workstation (GE Medical Systems). For the assessment of temporomandibular bone structures we applied the measurements applied recently by Vitral et al. (11, 12). The measurements performed in axial plane (Fig. 1) were: $H_{AP}$: the largest anteroposterior diameter of the condylar processes of the mandible, $H_T$: the largest mediolateral diameter of the condylar processes of the mandible, $H_{Ang}$: the angle between the long axis of the mandibular condylar processes and the midsagittal plane (Fig. 1b). R-L: anteroposterior difference of projections of condylar processes' geometric centers on the midsagittal plane. The projection of the center of the right process was considered the 0 point, e.g. anterior position of right condyle was presented as positive, and posterior as negative values (Fig. 1c).

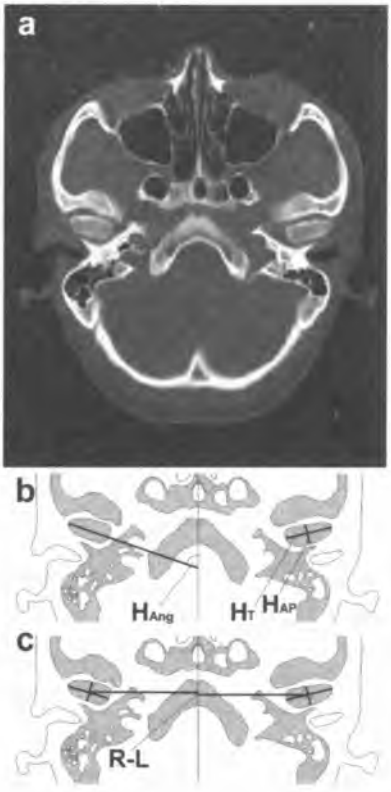


Fig. 1a–c. Parameters of condylar process of mandible measured in axial plane. Explanations of symbols in the text

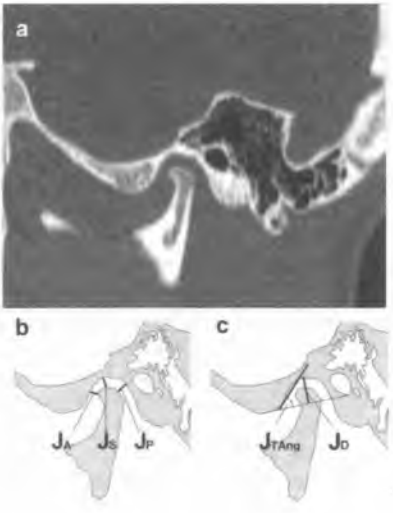


Fig. 2a–c. Parameters of TMJ measured in sagittal plane. Explanations of symbols in the text

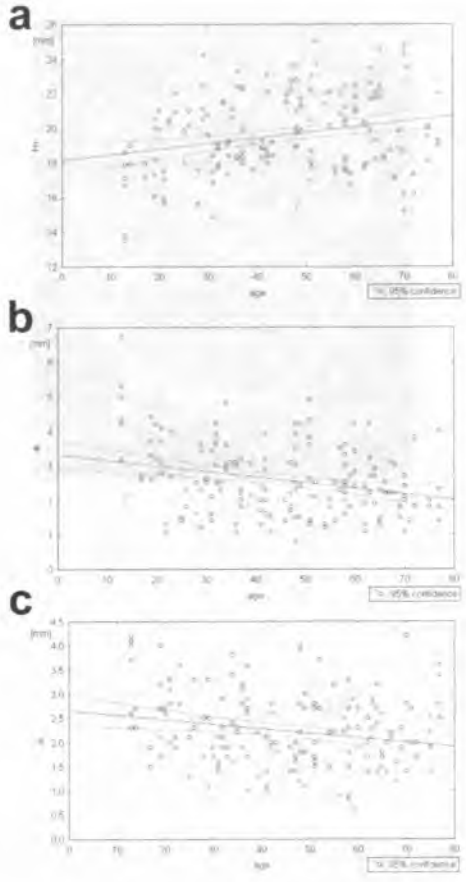


Fig. 3a-c. Scatterplots of measurements with statistically significant correlation with age. All correlations are weak positive (mediolateral dimension of mandibular head $H_T$, Figure a) or negative (superior and posterior joint space $J_S$ and $J_P$ – Figures b–c)

The parameters of temporomandibular fossa and joint space were measured in the sagittal plane (Fig. 2) obtained by means of multiplanar reformations. For evaluation of temporomandibular fossa we used the plane connecting the most inferior points of the auditory meatus and the most inferior point of the articular tubercle, later called the basal plane of the mandibular fossa. The following measurements are shown in Figure 2: $J_A$: anterior joint space: the shortest distance between the anterior margin of the mandibular condyle and the posterior wall of the articular tubercle, $J_S$: superior joint space: the shortest distance between the superior margin of the mandibular condyle and the most superior point of the mandibular fossa, $J_P$: posterior joint space: the shortest distance between the posterior margin of the mandibular condyle and the posterior wall of the mandibular fossa (Fig. 2a), $J_D$: depth of the mandibular fossa: distance between the most superior point of the mandibular fossa and the basal plane of the mandibular fossa, $J_{TAng}$: angulation of the anterior wall of the mandibular fossa: the angle between the tangent of the posterior wall of the articular tubercle and the basal plane of the mandibular fossa (Fig. 2b). Normal distribution of measurements was assessed by Kolmogorov-Smirnov test. The differences between male and female subjects were verified with t-Student test, with a significance level

$p \leq 0.05$ applied. For evaluation of age-related differences, the group was divided into 3 subgroups: group I below 30 years, group II 31–50 years and group III ≥ 51 years. T-Student test with a significance level $p \leq 0.05$ was used for comparative statistics.

## RESULTS

The results are presented in Tables 1 and 2. As no statistically significant differences of measurements of the right and left side were found, the measurements were grouped bilaterally. Pearson correlation was applied to estimate the linear relation of parameters of TMJ with the age of the subjects. Statistically significant ($p \leq 0.05$) weak positive correlation was found for mediolateral dimension of the mandibular condyle (correlation factor for $H_T = 0.25$), and weak negative correlation was found for measurement values of superior and posterior joint space, with correlation factor ranging from – 0.25 to – 0.20.

Table 1. Measurements of TMJ in male and female subjects. Parameters of distance shown as millimeters, angles as grades. Values presented as minimal, maximal, mean and standard deviation. Differences between gender groups with significance level $p \leq 0.05$ pointed out

| | Female | | | | Male | | | | p |
|---|---|---|---|---|---|---|---|---|---|
| | min | max | M | SD | min | max | M | SD | |
| $H_T$ | 14.9 | 23.7 | 19.01 | 2.03 | 13.5 | 25.0 | 20.35 | 2.49 | < 0.001 |
| $H_{AP}$ | 5.8 | 11.9 | 8.46 | 1.28 | 5.2 | 11.6 | 8.67 | 1.21 | 0.2590 |
| $H_{Ang}$ | 45.2 | 88.0 | 70.13 | 8.87 | 42.3 | 88.2 | 68.31 | 7.41 | 0.1443 |
| R-L | -6.1 | 10.0 | 2.63 | 1.75 | -3.9 | 7.0 | 1.12 | 3.23 | 0.526 |
| $J_A$ | 0.90 | 4.00 | 2.24 | 0.69 | 1.0 | 5.0 | 2.22 | 0.77 | 0.8351 |
| $J_S$ | 0.30 | 4.10 | 2.11 | 0.80 | 1.1 | 4.2 | 2.47 | 0.74 | < 0.001 |
| $J_P$ | 0.80 | 5.30 | 2.38 | 0.95 | 1.1 | 8.8 | 3.05 | 1.62 | < 0.001 |
| $J_D$ | 6.20 | 11.90 | 8.31 | 1.08 | 3.2 | 16.2 | 8.32 | 1.69 | 0.9362 |
| $J_{TAng}$ | 29.50 | 67.10 | 47.89 | 7.56 | 10.0 | 66.6 | 46.55 | 9.20 | 0.9216 |

Table 2. Measurements of TMJ in age-related subgroups. Parameters of distance shown as millimeters, angles as grades. Values of measurements are presented as mean and standard deviation. P values, which indicate statistically significant differences ($p \leq 0.05$) between groups I–II and II–III were pointed out

| | Group I | | p | Group II | | p | Group III | |
|---|---|---|---|---|---|---|---|---|
| | M | SD | | M | SD | | M | SD |
| $H_T$ | 18.45 | 1.36 | >0.001 | 20.16 | 2.05 | 0.646 | 19.89 | 2.49 |
| $H_{AP}$ | 8.79 | 0.95 | 0.169 | 8.40 | 0.97 | 0.968 | 8.41 | 1.28 |
| $H_{Ang}$ | 67.62 | 2.13 | 0.083 | 69.63 | 6.56 | 0.787 | 70.17 | 8.94 |
| R-L | 0.60 | 2.41 | 0.124 | 1.71 | 3.02 | 0.533 | 3.88 | 21.88 |
| $J_A$ | 2.09 | 0.59 | 0.195 | 2.26 | 0.76 | 0.929 | 2.24 | 0.56 |
| $J_S$ | 2.53 | 0.79 | 0.005 | 2.12 | 0.75 | 0.820 | 2.15 | 0.72 |
| $J_P$ | 3.21 | 1.25 | 0.003 | 2.50 | 0.94 | 0.672 | 2.42 | 0.83 |
| $J_D$ | 7.98 | 1.20 | 0.021 | 8.57 | 1.76 | 0.266 | 8.28 | 1.31 |
| $J_{TAng}$ | 45.12 | 8.58 | 0.059 | 48.00 | 8.74 | 0.134 | 45.76 | 7.22 |

## DISCUSSION

Computed tomography is a recognized imaging modality of temporal bone and temporomadibular joint. According to Kahl et al. (6) it shows excellent agreement with surgical findings in TMJ surgery, and sagittal projections are particularly useful for examination of joint space, condyle-fossa relationship and depth and anterior angulation of the mandibular fossa.

We found no significant differences between right and left TMJs, which corresponds to results of Blaschke (1), who found a mild correlation of individual joint relationships between the sides in asymptomatic patients.

Some measurements of TMJ showed age-related significant differences between the youngest and older patients groups. The results of the smallest p value – $H_T$, $J_S$ and $J_P$ were found to show weak significant correlation with the age of the subjects.

We found no significant age-related differences between the oldest patients group and the remaining ones. Toure et al. (10) found significant radiographic signs as osteophytes, geodes and joint narrowing in almost half of their elderly patients group. However, in their study the group included subjects ≥75 years only, with mean age of 91.8±4.7 years. According to weak negative correlation of superior joint space in our group, possibly the joint space in the older group would be narrower than in younger groups.

However, nonconcentric position of mandibular condyle was reported in patients with malocclusion (3, 12); Blaschke (1) described this asymmetry as feature of normal TMJ, which corresponds to our results, where the anterior joint space in the whole group was significantly ($p < 0.001$) smaller than the posterior one with 2.15 mm vs. 2.58 mm, respectively.

For the measurement of the condylar angulation, the values were 70.13° in females, and 68.31° in males. Christiansen et al. (2) found values of 66.1 and 64.6 respectively. Raustia (8) suggested values ranging from 58 to 90 to be considered as normal. Significantly wider condylar process and superior and posterior joint spaces found in male subjects, as well as significant differences of TMJ measurements in young patients should be considered while evaluating the bone structures of TMJ with MSCT.

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## SUMMARY

The paper presents research on parameters of the temporomandibular joint (TMJ) measured with multislice computed tomography (MSCT) in 150 asymptomatic subjects. The aim of the study was to evaluate differences of the parameters in different age and gender groups. The results of the study show a significantly larger condylar head in male subjects, with its transverse diameter of 20.35±2.49 mm, as compared to 19.01±2.03 mm in females. Male subjects presented significantly wider superior (2.47±0.74 mm) and posterior joint space (3.05±1.62 mm). Weak positive correlation of the mediolateral dimension of mandibular head with the age was found as well as weak negative correlation of superior and posterior joint space with the age of the subjects. Significant differences of TMJ measurements for age-related groups were found in youngest group only, where mediolateral dimension of the mandibular condyle and depth of joint cavity were significantly smaller, and superior and posterior joint space significantly wider as compared to older age groups.

Różnice wymiarów stawu skroniowo-żuchwowego związane z wiekiem i płcią w grupie pacjentów bezobjawowych badanych w wielorzędowej tomografii komputerowej

W pracy zaprezentowane są wyniki pomiarów stawu skroniowo-żuchwowego w tomografii komputerowej u osób bez objawów dysfunkcji stawu. Celem pracy była ocena różnic tych pomiarów związanych z wiekiem i płcią, co może być przydatne w diagnostyce patologii tego stawu. W grupie mężczyzn stwierdzono statystycznie istotne różnice pomiarów wymiaru poprzecznego głowy żuchwy oraz szerokości górnej i tylnej części szpary stawowej. Stwierdzono słabą dodatnią korelację między wymiarem poprzecznym głowy żuchwy oraz słabą ujemną korelację wartości szerokości górnej i tylnej części szpary stawowej z wiekiem badanych. W najmłodszej grupie wiekowej stwierdzono istotnie mniejsze wartości wymiaru poprzecznego głowy żuchwy i głębokości stawu skroniowo-żuchwowego w porównaniu z grupami starszymi. Wartości szerokości górnej i tylnej części szpary stawowej były w grupie najmłodszej istotnie szersze w porównaniu z grupami starszymi.