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Clinical Paper
TMJ Disorders

Correlation of gender and age with magnetic resonance imaging findings in patients with arthrogenic temporomandibular disorders: a cross-sectional study

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Abstract. The objective of this study was to analyse the correlation between the gender and age of individuals with arthrogenic temporomandibular disorders (TMDs) and magnetic resonance imaging (MRI) findings. A total of 199 patients were included in the study and were divided into four age groups: group A, ≤30 years; group B, 31–44 years; group C, 45–55 years; group D, ≥56 years. MRI scans were analysed for the presence or absence of the following conditions: morphological changes in the mandibular condyle and/or articular tubercle, disc displacement with (DDWR) and without reduction (DDWoR), bone oedema, effusion, and avascular necrosis. Statistical analyses were conducted using logistic regression models ($P < 0.05$). The mean patient age was 44.47 ± 16.39 years; 158 (79.4%) were female and 41 (20.6%) were male. Only DDWoR was more significantly found in females than in males ($P < 0.05$). Group D showed an odds ratio three times higher for the presence of morphological changes than group A (odds ratio 3.042, 95% confidence interval 1.421–6.512; $P = 0.0042$). No differences were found among groups for the other findings. Based on the results of the present study it may be concluded that MRI findings tend to differ according to age and gender.

Key words: temporomandibular disorder; magnetic resonance imaging; gender; age groups; epidemiology.

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Temporomandibular disorder (TMD) is a term used to describe a group of conditions that affect the stomatognathic system. Typical TMD symptoms are pain in the jaws, decreased mouth opening, and the production of sounds/clicks in the temporomandibular joint (TMJ).[1] TMD is considered the leading cause of orofacial pain of non-dental origin, and the reported prevalence of TMD ranges from 16% to 88% of the population worldwide.[2–4]

The diagnosis of patients with TMD involves a detailed investigation of the case history, followed by a series of intra- and extraoral physical examinations, as well as complementary examinations whenever deemed necessary. Magnetic resonance imaging (MRI), a non-invasive imaging test, is the primary imaging technique in the diagnosis of TMJ dysfunction.[5–7] MRI scans present high soft tissue contrast and great accuracy in the visualization of the anatomy of TMJ bony structures. Additionally, dynamic images may also be acquired to demonstrate joint functionality.[7–9] Thus, MRI is capable of demonstrating changes in the articular disc, where computed tomography (CT) scans and X-rays cannot.[7]

Studies have shown that females are more frequently affected by TMD than males,[3,10–13] leading to the belief that imaging findings such as disc displacement, effusion, and osteoarthritis are more common in women than in men.[14,15] With regard to age distribution, evidence seems to suggest that the presence of TMD is characterized by a Gaussian curve, i.e., peaking between 35 and 45 years, being less prevalent in the young and in the old.[2,3,16] However, the literature on this matter remains inconclusive, as peak age is not always the same for all TMD diagnoses. The presence of TMJ disc displacement is more common between the second and fifth decades of life,[2–4,11,14] while the presence of osteoarthritis is more common in the fourth and fifth decades.[2,3,13] In regard to effusion, this is expected to be more common in younger individuals,[13] while avascular necrosis is expected to be more common in older patients.[17]

Although several studies focusing on patients with TMDs have been performed, only a few have attempted to establish a correlation between patient sex and age and imaging findings. Evidence suggests that differences in diagnoses among the different age groups require further investigation.[2–4]

Therefore, the aim of this study was to evaluate the correlation of sex and age group with MRI findings in individuals diagnosed clinically with arthrogenic TMD. The null hypothesis to be tested was that the prevalence of the imaging findings in the conditions studied would not differ between the sexes or among the different age groups.

Materials and methods

This observational cross-sectional analytical study, using secondary data, was approved by the ethics committee for research involving human beings of the local institutional review board.

The study group consisted of 199 consecutive patients of both sexes with evidence of arthrogenic TMD. The clinical TMD diagnosis was conducted in accordance with previously established clinical diagnostic criteria for TMD.[18] The cases were drawn from individuals referred for MRI of the TMJ because of a history of clinical signs and symptoms of TMJ dysfunction (such as mandibular deviation–deflection), and/or the presence of a limited inter-incisal opening or limited mouth opening, and/or joint noise/clicking during mouth opening and closing. All subjects underwent an MRI investigation of the TMJ in an orofacial pain and deformity centre (Cenddor) in Porto Alegre, Brazil, from January 2007 to January 2014. Patients with a clinical history of rheumatoid arthritis, agenesis, hyperplasia, hypoplasia and/or malignant neoplasms of the mandibular condyle, bone ankylosis, previous TMJ surgery, and/or any type of surgery to the face that might interfere with image analysis, were excluded from the sample.

Participating patients were divided into four age groups based on a methodology described previously,[2–4] using the percentile age intervals of the study population. As a result, patients were distributed as follows: group A, age $\leq$30 years; group B, age between 31 and 44 years; group C, age between 45 and 55 years; group D, age $\geq$56 years.

Magnetic resonance imaging

MRI examinations were performed with a 1.5-T imaging system (Signa HDxt; GE Healthcare, Milwaukee, WI, USA) with the use of dual surface coils 9 cm in diameter. Sequences were performed with T1-weighted images, employing a repetition time (TR) of 567 ms and echo time (TE) of 11.4 ms. For T2-weighted images, TR of 5200 ms and TE of 168.5 ms were used. T1-weighted data were collected on a 288 $\times$ 192 dots/cm matrix, with number of excitations (NEX) = 3, while T2-weighted data were collected on a 288 $\times$ 160 dots/cm matrix, with NEX = 4 and a field of view (FOV) of 11 cm $\times$ 11 cm.

T1- and T2-weighted images with 3-mm slices were obtained for each TMJ in the oblique sagittal plane, perpendicular to the axis of the mandibular condyle, in maximum intercuspation and maximum mouth opening. Moreover, images of the TMJ were also obtained in the oblique coronal plane, in maximum intercuspation only. In order to locate the image of the mandibular condyles (scanogram), an axial section was first performed to obtain an image parallel to the axis of the mandibular condyle. An individual non-ferromagnetic intermaxillary device was used to keep the patient relaxed, minimize movement, and maintain the maximum mouth opening previously identified in the clinical examination.

The film used was 43 cm $\times$ 35 cm, with 12-image documentation (3 $\times$ 4) and 1.5-times magnification. Each set of images was analysed by the same experienced radiologist, who was completely blind to the clinical diagnosis received by the patient. Image analyses were conducted according to the criteria defined by Larheim et al.[19] and Ahmad et al.[20]

The presence or absence of the following conditions was assessed in the images obtained from each TMJ: morphological changes in the mandibular condyle and/or articular tubercle (Fig. 1), disc displacement with reduction (DDWR) (Fig. 2), disc displacement without reduction (DDWoR) (Fig. 3), bone oedema (Fig. 4), effusion (Fig. 5), and avascular necrosis (Fig. 6).

Statistical analysis

The Hosmer and Lemeshow logistic regression test was applied to compare the different age groups concerning each type of imaging finding.[21] First, by taking the data of the entire sample (n), the frequency of the presence of all findings involved in the study was identified. Then, a sub-sample (n_i) composed only of those individuals who presented the finding in question was established for each finding. After that, each sub-sample, n_i, was divided according to the age group. Thus, the logistic regression model was performed taking the n_i of each specific finding and characterizing an independence criterion among the groups as the basis for conducting the analyses. For comparisons between the sexes, in which the individual was adopted as the observational unit, the χ^2 test and Fisher's exact test were used. All analyses were performed using R version 3.0.2 (R Foundation for

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