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General Summary

1. Clinical studies of temporomandibular disorders

We continued our studies of screening questionnaires and evaluation of quality of life in patients with temporomandibular disorders (TMDs).

2. Morphological and histological studies of the temporomandibular joint

We continued our anatomical and histological examinations of the temporomandibular joint (TMJ) and articular disk in Mammalia.

3. Clinical studies of obstructive sleep apnea-hypopnea syndrome

We examine the relationship between body-mass index (BMI) and the fatty change of the suprahyoid muscles in patients with obstructive sleep apnea (OSA).

Research Activities

Clinical studies of TMDs

1. Time trend for clinical background factors of patients with TMDs at general clinical offices in metropolitan Tokyo

Purpose: We have developed a 4-item questionnaire to screen patients for TMDs, and a portion was used for a Ministry of Health, Labour and Welfare survey of dental diseases, and with the cooperation of the Tokyo Dental Association, we performed a questionnaire survey of applicants for dental checkups at general dental offices in Tokyo. We reported personal computer (PC) duties and their connection with TMDs in 2011 and 2012. In 2007, 2009, and 2012, we performed a questionnaire survey with the Tokyo Dental Association. On the basis of these 3 investigations, we reviewed annual transition of the PC operation times when they were thought to affect results of the TMD screening test.

Methods: We analyzed secondary data of the Tokyo Dental Association for 2007 (180 subjects: 101 men and 79 women) and 2009 (76 subjects: 54 men and 22 women), and 2012 (69 subjects: 13 men and 56 women).

Results: "PC operation time" increased significantly each year (Kruksal-Wallis analysis). We also recognized a difference in mean values among the 3 groups (Mann-Whitney test). The effect size (r) showed an appropriate value. The Spearman correlation coefficient showed weak negative correlations of "PC operation time" with "long time before going to bed" and "sleep time."

Conclusion: The increasing "PC operation time" each year and the time of going to bed shortening after return suggest that further investigation is necessary.

2. Epidemiological characteristics of patients with TMDs in Japan

Purpose: In 2007, Sugisaki et al. developed a 4-item questionnaire for screening patients for TMDs: it showed a sensitivity of 0.746 and a specificity of 0.811. In the same year,

they reported the validity of a single binary scale (yes/no) question: "When you open your mouth widely and/or close it, do you feel pain in your jaw?" from the 4-item questionnaire (sensitivity, 0.701; specificity, 0.871). In this study, we examined the epidemiological characteristics of patients with TMD in Japan using the TMD screening questionnaire mentioned above.
Methods: We analyzed several epidemiological reports: 1,071 people working in Tokyo in 2005 (study 1), 1,969 people working at a single company assessed by Nishiyama et al. in 2007 (study 2), the National Survey of Dental Diseases in 2005 and 2012 (study 3), and the National Adult Dentistry Health Investigation in 2007 (study 4), which used the same TMD screening items.
Results: The percentages of persons complaining of jaw pain were 3.4% (in 2005) and 3.3% (in 2012) in study 3 and 3.5% in study 4. The rates of jaw pain found in study 1 for people working in the Tokyo metropolitan area were 17.9% with the 4-item questionnaire (in 2005 and 2006) and 20.0% with the single binary-scale question (in 2006). Moreover, the rate in study 2 was 22.6%.
Conclusion: The prevalence of TMD in employed subjects is higher than that of the general public.

Anatomical studies of the TMJ of marsupials

1. Absence of the articular disk in the Tasmanian devil TMJ

Purpose: The articular disk of the TMJ is a conserved structure in mammals. According to Parsons' report in 1900, however, the articular disk is absent in 4 animals: the armadillo, 2 kinds of monotreme, and the Tasmanian devil. Thereafter, no research was performed to confirm this observation. The aim of this study was to determine with anatomical and histological examination whether the Tasmanian devil TMJ has an articular disk.
Methods: Six fresh-frozen corpses and 1 dry skull of Tasmanian devils were obtained from the School of Zoology, University of Tasmania. The corpses were dissected, and the morphology of the TMJ was carefully observed through gross anatomical and histological examination. The structure of the TMJ of the dry skull was examined macroscopically and with micro-computed tomography (CT).
Results and Conclusion: In all cases, absence of the articular disk in the Tasmanian devil TMJ was morphologically confirmed. The surface layer of both the condyle and the glenoid fossa comprised thick fibrous tissue. Micro-CT revealed dense and fine trabecular bone in the condyle. The thick fibrous tissue covering the condyle and high-density trabecular bone in the condyle might play a role in absorption against powerful mastication and the heavy loading of the Tasmanian devil TMJ.

Clinical studies of OSA-hypopnea syndrome

1. The effect of fatty changes in the lingual muscles and BMI on the apnea-hypopnea index

Purpose: A change in muscle function has been postulated to be associated with the etiology of OSA. Saito and colleagues have reported on the effect of obesity on the properties of the lingual muscles (genioglossus and geniohyoid) in rats [Arch Oral Biol (2010;

55(10): 803–808]). However, on the basis of previous images, fat-to-muscle metamorphosis has not been shown in humans. Here, we show evidence of fatty metamorphosis in the lingual muscles in CT images of patients with suspected OSA.

Methods: The subjects were 62 patients (47 men and 15 women) with suspected OSA who had visited the Tsurumi University School of Dental Medicine from November 2007 through October 2011. All subjects gave informed consent to take part in the study. Subjects underwent CT evaluations at the imaging diagnosis department of the hospital. Sex, age, BMI, and the apnea-hypopnea index (AHI) were recorded for each patient. Inferior airway space and the total value of the length and width of the inferior airway space (TIAS) were also measured. The degree of fat-to-muscle metamorphosis was measured with CT. Image-analysis software (Aze Win, Aze Ltd., Tokyo, Japan) was used to set the regions of interest (ROIs) of 30 mm^2 on the bellies of the lingual muscles. We measured CT levels of 4 ROIs (both sides of the central area and both sides of the posterior area) in the genioglossus muscles and 2 sizes of ROI (both sides of the central area) in the geniohyoid muscles. Values were quantified and compared statistically.

Results: The median values (and 25% and 75% quartile deviations) were as follows: patient age, 51.50 years (42.75, 62.25); BMI, 24.00 kg/m^2 (22.00, 26.00); AHI, 24.35 (11.40, 36.10), genioglossus CT levels, 123.05 (90.95, 135.70); geniohyoid muscle CT levels, 111.20 (104.80, 116.30); and TIAS, 34.65 (25.97, 40.62). Analysis of the results of a multiple regression model with Amos (Version 6) software (Amos Development Corporation, Spring House, PA, USA) showed that the standardized estimates of the BMI were -0.50 ($p = 0.000$) for the genioglossus muscle and -0.42 ($p = 0.000$) for the geniohyoid muscle. The standardized estimate of BMI of the distance of the TIAS was -0.55 ($p = 0.001$), and that of the AHI of the TIAS was -0.48 ($p = 0.000$).

Conclusions: Consistent with the report of Saito et al, we found evidence of fatty metamorphosis of the lingual muscles of humans with effects on the TIAS and AHI.

2. The relation of fatty changes in lingual muscles and BMI with high AHI

Introduction: A change in muscle function has been postulated to be associated with the etiology of OSA. At the 17th annual meeting of the Japanese Society of Dental Radiology we reported fatty changes in the lingual muscles of a patient with suspected OSA. We have shown evidence of fatty metamorphosis in the lingual muscles and its relation to BMI using CT images of patients with high AHI (more than 30) and diagnosed OSA.

Methods: The subjects were 26 patients with high AHI from among 62 patients (47 men and 15 women) with suspected OSA who visited the Tsurumi University School of Dental Medicine from November 2007 through October 2011. All subjects gave informed consent to take part in the study. Subjects underwent CT evaluations at the image diagnosis department of the hospital. Sex, age, BMI, and AHI were recorded for each patient. The degree of fat-to-muscle metamorphosis was measured with CT. Image analysis software (Aze Win) was used to set ROIs of 30 mm^2 on the bellies of the lingual muscles. We measured CT levels of 4 ROIs (both sides of the central area and both sides of the posterior area) in the genioglossus muscles and two sizes of ROI (both sides of the central area) in the geniohyoid muscles. Values were quantified and compared statistically. Using the total value, BMI and fat examined relations with becoming it.

Results: The median values (25% and 75% quartile deviations) were as follows: patient age, 58.00 years (48.75 and 70.00 years); BMI, 25.00 kg/m^2 (23.00 and 28.00 kg/m^2); genioglossus CT levels, 111.05 Hounsfield units (HU) (82.97 and 134.60 HU); and geniohyoid muscle CT levels, 106.05 HU (96.47 and 116.10 HU). Analysis of the results of a multiple regression model with Amos (Ver. 6) software showed that the standardized estimates of the BMI were −0.43 (p = 0.006) for the genioglossus muscle and −0.55 (p = 0.000) for the geniohyoid muscle.

Conclusions: Our results show relationships of the fatty metamorphosis of lingual muscles and BMI with high AHI.

Publications

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