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Association between Bite Force and TMD Symptoms in Young Adults

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ABSTRACT *In the subjects with TMD, the asymmetry of bite force is considered important parameters for functional state of occlusion. The purpose of this study is to investigate the bite force and its association with TMD symptoms in young adults' population.*

138 dental students were used for experimental subjects. The basic items of clinical examinations were based on the Helkimo index. The bite forces were measured by Dental Prescale. The subjects were asked to bite the sheet as strong as possible for 3 seconds in intercuspal position. Analyses were performed between the symptoms of subjects and their bite force parameters, and between the signs of subjects and their bite force parameters.

For the subjects without symptoms, the moment in male was significantly bigger than that of female ($p<0.05$). The asymmetry index for the average occlusal pressure of female was larger than that of male ($p<0.01$). As for some degree of sex differences were found, the further analysis was assessed in males and females separately. There were no significant differences of bite force parameters without symptoms had more bite force and moment than subjects with symptoms ($p<0.05$).

There was some degree of sex difference in the bite force measurement. Only for males, the bite force and moment in subject without symptoms showed significantly larger than subjects with TMD symptoms.

Key words : Temporomandibular joint disorders(TMD), Occlusal force, Signs and symptoms, Helkimo index, Correlation

INTRODUCTION

Patients with TMD have been reported to have lower maximal bite force values than healthy subject[1~5]. The difference in maximal bite force values between males and females biting in the molar region was highly significant[6~9] and is explained by males' greater muscular potential, even the size differences of muscles are taken into account[10]. Separate evaluation of genders would be advisable in studies involving bite force assessments[11].

Increasing in bite force up to 'normal' levels has been reported to follow successful treatment of TMD[3]. But maximal bite force values have not always been found to be lower for TMD patients than for healthy controls or in the non-patients study[11~13].

With the developing of Dental Prescale®, it has become possible to measure the distribution of bite force on all teeth in closely resemble condition to the intercuspal occlusion without the subject's fear of dental damage than other methods[14,15]. With this method, one report have been published about the TMD patients' bite force[16], but no studies have been done in an unselected non-patient young adults' population.

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The purpose of this study is to compare the bite force using Dental Prescale® in the non-patient subject group.

MATERIALS AND METHODS

138 forth-year dental students in Asahi University were investigated. Excluding the orthodontic experienced samples. They were 96 males, 42 females with averaged 22.5 years old.

The clinical examination was performed by the same examiner. The basic items based on the Helkimo index. The clinical sign evaluation was based on the Helkimo clinical dysfunction index(Di).The symptoms of TMD were assessed on the basis of the anamnestic dysfunction index (Ai).

The bite force was measured to the 138 subjects who had finished the questionnaire, by using pressure-sensitive sheets (Type-R 50H Dental Prescale, Fuji Film Co., Tokyo Japan) and an image scanner (FPD-703, Fuji Film Co.). The subjects were asked to tapping their teeth first with confirming their intercuspal occlusal position, and then instructed to bite the sheet as strong as possible for 3 seconds in a relaxed upright position. The sheet was scanned in 10 hours or so, which had been preserved in refrigerator (5℃). Only the data, in which the percentage of valid contact pressure was bigger than 95%, were used in the statistical analysis.

Analyses were performed between the symptoms of 138 subjects and their bite force parameters, and between the signs of 71 subjects and their bite force parameters. The bite force parameters included : occlusal contact area, average bite pressure, bite force, moment and their unbalance of parameters. The asymmetry index for parameters was defined as : | left-right | /(left+right)×100%. Sex difference were analyzed in the subjects without symptoms (Ai0), in the subjects with symptoms Ai (I+II), subjects without signs (Di0) and subjects with signs Di (I+II) respectively.

SPSS 9.0 for windows (SPSS Japan Inc.) was used for statistics. To analyze the sex difference of bite force and the bite force between subjects with and without signs or symptoms, the pooled-variance t test was used for equal variances condition, otherwise the separate-variance t test was chosen.

RESULTS

Sex difference of the bite force

For the subjects without symptoms in the 138 subjects, the moment of male was significantly bigger than that of female ($p<0.05$, Fig. 1).

The asymmetry index for the average occlusal pressure of female was larger than that of male ($P<0.01$, Fig. 2).

There were no significant differences both in subjects with and without symptoms for the occlusal contact area, the bite force and their asymmetry index.

For the subjects with signs among the 71 subjects, females had less occlusal bite area than males did ($p<0.05$, Fig. 3).

Association between bite force and TMD

As for some degree of sex differences were

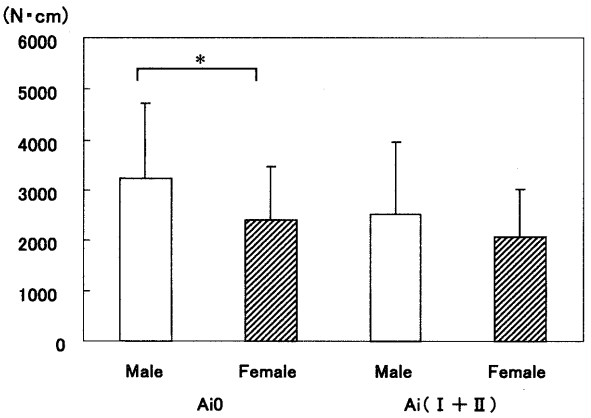

Fig. 1. Sex difference of the moment in the subjects with and without symptoms ($p<0.05$).

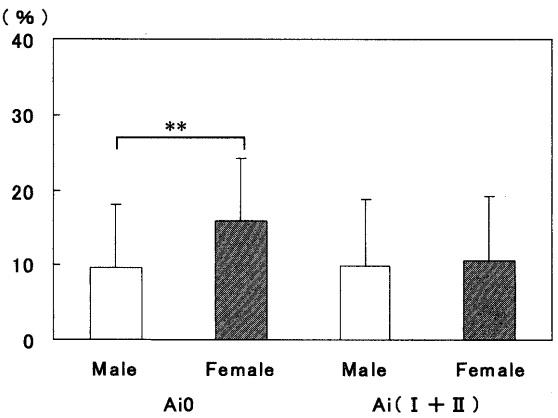

Fig. 2. Sex difference of the asymmetry index for average in the subjects with and without symptoms ($p<0.05$).

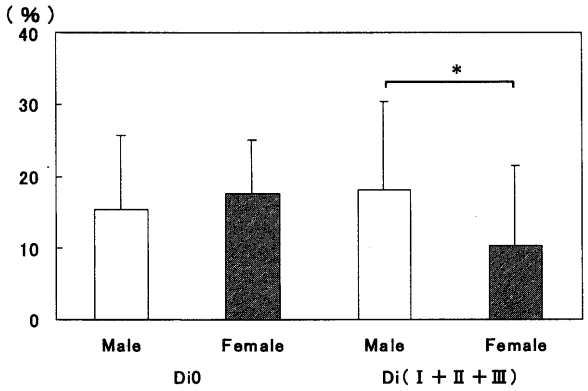

Fig. 3. Sex difference of the asymmetry index for the occlusal contact area in the subjects with and without symptoms ($p<0.05$).

found, the further analysis was assessed in males and females separately.

In the 138 subjects, there were no significant difference of occlusal bite area, average bite pressure, bite force, moment and their unbalance of parameters for females between subjects without symptoms and subjects with symptoms; but for males, the subjects without symptoms had more bite force and moment than subjects with symptoms ($p<0.05$, Fig. 4 and Fig. 5).

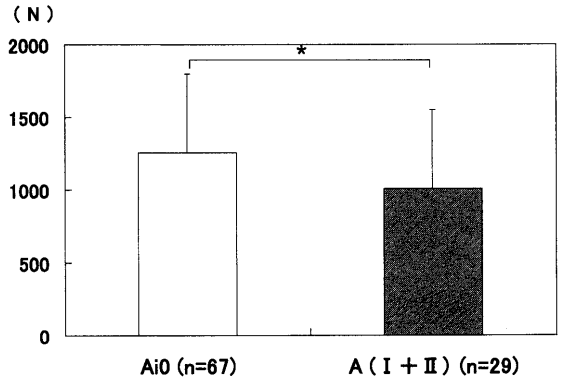

Fig. 4. Bite force between subjects with symptoms Ai (I + II) and without symptoms (Ai0) for males ($p<0.05$).

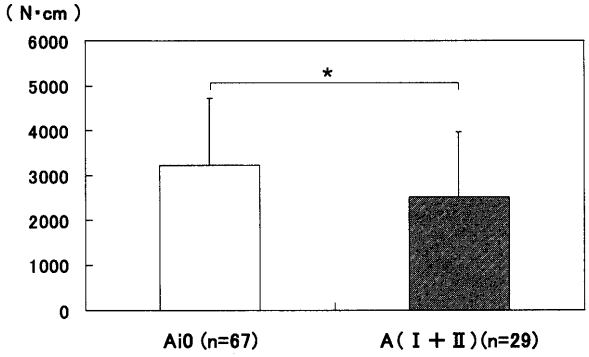

Fig. 5. Moment between subjects without symptoms (Ai0) and with symptoms Ai (I + II) for males ($p<0.05$).

DISSCUSSION

Among the methods to measure the bite force distribution simultaneously nder clenching, the Prescale® is considered a relative ideal one[14]. The photocclusion technique make use of a polymer sheet to register occlusal contacts in the form of birefringence strain patterns[17~19], but the quantitative measurement of the bite force is difficult. Although T-scan system is useful to observe the bite force changing with time, the value of bite force tends to smaller with maximum clenching because of narrow maximum measuring range. Other defects of T-scan include low sensitivity and planar resolution capacities[20], misleading reproductions resulted from contact area shifting, uncomfortable feeling and possible shift of the mandible because of the inflexible sensor foil[21].

The Dental Prescale® is a flexible horseshoe-shaped sheet with a thickness of 97μm. The red-color density, result of a color-developing chemical reaction induced by bite force to break the micro-capsules that contain the color-forming materials, reflects the degree of occlusal load applied to the sheet[15]. The bite force and occlusal contact area on each tooth in the intercuspal position can be observed simultaneously and more reliably[15]. Moreover the balance of bite force can also be obtain easily.

For the 50H type sheet used in this study, the measurable occlusal pressure range is from 5.0 MPa to 120.0 MPa. If the maximum occlusal pressure is over 120 MPa, the only way to overcome the doubt for reliability of bite force, which is the accumulation of forces on the all occlusal areas, is to only adopt the data of which the available bite pressure is more than 95%. In this study, the maximum occlusal pressure of about 20% of subject was equal (may be over) 120 MPa. But only 3 subjects' available contact pressure is less than 95%, whose data were re-taken until the available contact pressure is over 95%.

There have been several studies about the bite force of TMD patient based on the Dental Prescale®. Under maximum clenching, the values of occlusal contact area, bite forces in patients were significantly smaller than the control group[16]. But no research discussed about the sex difference. In this

study, sex differences were found : in subjects without symptoms, females had bigger moment and asymmetry index for average occlusal pressure ; In subjects with TMD signs, females had more occlusal area than males. As for this fact, it was more reasonable to discuss the association between the bite fore and TMD in males and females separately.

In the non-patients adults in this study, not all the parameters related to bite force showed the difference between subjects with TMD and without TMD symptoms. It was only found that male subjects without TMD symptoms had bigger bite force and moment than the male subjects with TMD symptoms.

Hidaka et al.[22] recently found out that the medio-lateral position of the bite force balancing point (correspond to the unbalance of the moment in our study) shifted to the midline with the clenching intensity increased. It is imply that there was an insensitive to the asymmetry nature maybe existed in the TMD subjects under the maximum biting which had been instructed to the subjects in this study.

CONCLUSION

There was some degree of sex difference in the bite force measurement. Only for males (in the 138 subjects), the bite force and moment without symptoms showed significantly larger than subjects with TMD symptoms.

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青年における顎関節症の症状と咬合力との関連性

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キーワード：顎関節症，咬合力，症状と徴候，Helkimo index，関連性

抄録　顎関節症患者では，咬合力の不均衡は咬合の機能的状態の把握には重要なパラメータである．この研究の目的は，青年における顎関節症の症状と徴候の咬合力との関連性を調べることにある．

実験には138人の歯学部学生が参加した．臨床診査の基本は，Helkimo indexに基づいた．咬合力はプレスケール(富士写真フィルム)とイメージ・スキャナーにより測定された．被験者は，3秒間できる限り強くシートを噛むように指示された．分析は，被験者の症状また徴候と咬合力の各パラメータとの関連性について行われた．分析したパラメータは，咬合接触面積，平均圧力，咬合力，モーメント，およびそれらのパラメータのAsymmetry Index (AI)である

顎関節症の徴候のない138人では，男性のモーメントは女性のそれより有意に大きかった．女性の平均圧力AIは，男性のそれより有意に大きかった．平均値で男女差があるパラメータが見つけられたため，男女毎との分析の必要生が示唆された．女性の被験者において，徴候の有無による咬合接触面積，平均圧力，咬合力，モーメント，およびAIにおいて有意な差はなかった．しかし，男性被験者においては徴候のない方が有意に大きい咬合力とモーメントを示した．

以上の結果から，咬合力測定においてあるの程度の男女差があること，男性においてだけ徴候のないものの方が有意に大きい咬合力とモーメント示すことがわかった．