

# Association Between Contact from an Overerupted Third Molar and Bilaterally Redistributed Electromyographic Activity of the Jaw Closing Muscles

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**Aims:** To determine whether the facial side of an overerupted third molar and/or the side exhibiting symptoms of temporomandibular disorders (TMD) has an association with the bilateral distribution of occlusal contact number, occlusal force, or surface electromyographic (SEMG) activity of the anterior temporalis (TA) and masseter muscles. **Methods:** Nineteen patients with unilateral TMD symptoms and one overerupted mandibular third molar were enrolled. Occlusal contacts and the SEMG activity of the anterior temporalis and masseter muscles were recorded simultaneously during maximal voluntary clenching (MVC) in the intercuspal position (ICP-MVC) and in the protrusive edge-to-edge position (Pro-MVC). The associations between the side of overeruption/TMD symptoms and the  $\Delta$  values of the differences between the right- and left-side values for the number of occlusal contacts, sectional force value (defined as the ratio of the anterior or posterior sectional arch bite force of the right or left side to the total arch force {SFV}), and SEMG activity of the temporalis and masseter muscles were analyzed. **Results:** The overeruption side ( $P < .050$ ), but not the symptomatic side ( $P > .050$ ), showed an association with the  $\Delta$  values, with higher SFVs of the posterior arch and lower values for temporalis SEMG activity in the 100%, 75%, and 50% protrusive clenching positions and larger numbers of occlusal contacts in the posterior arch in the 100% and 75% protrusive clenching positions than the non-overeruption side. **Conclusion:** The pattern of occlusion, but not TMD symptoms, had an association with the number and distribution of the occlusal contacts, occlusal force, and temporalis SEMG activity. *J Oral Facial Pain Headache* 2018;32:358–366. doi: 10.11607/ofph.2022

**Keywords:** bite force, electromyography, jaw-closing muscle, occlusal contact, third molar overeruption

One or more third molars are often absent in human beings, frequently causing the unopposed third molar(s) to overerupt and interfere with chewing. Kiliaridis et al<sup>1</sup> and Craddock and Youngson<sup>2</sup> found that more than 82% of unopposed teeth overerupted and that 51.6% were involved in occlusal interferences. The concept of occlusal interference has been discussed frequently in the literature, but most descriptions have been related to altered centric and eccentric jaw movement.<sup>3</sup> Although the strength of the tooth contacts is occasionally discussed as a sign of occlusal disease<sup>4</sup>—for example, the vibration felt in the teeth during occlusion<sup>4</sup>—few studies have described it. This also applies to the overerupted third molar. Although an overerupted third molar often exerts an interfering contact during protrusive clenching or biting, few studies have detected its strength. Instead, the association between dental occlusion and jaw muscle surface electromyographic (SEMG) activity is frequently reported, given that occlusal force is generated by jaw muscles.<sup>5</sup>

Besides the direction<sup>6,7</sup> and magnitude of biting forces,<sup>5</sup> occlusion is often described in terms of the number and location of contacts<sup>7,8</sup> and the occlusal support distribution.<sup>9,10</sup> The T-Scan III system (Tekscan) provides further information about occlusion, such as the location, size, and relative strength of the occlusal contacts, and can be simultaneously used along with the SEMG recordings of the jaw muscles.<sup>11</sup> This combination allows investigators to analyze the association

between occlusal features, such as the overeruption of a mandibular third molar, and the accompanying SEMG activity of the target muscles.<sup>12,13</sup>

Abnormal jaw-closing muscle activities have been linked to temporomandibular disorders (TMD).<sup>14</sup> However, the characteristics of SEMG activity in TMD patients have never been well-identified. It has been reported that the severity of TMD is positively correlated with the SEMG activities of the anterior temporalis and masseter muscles<sup>15</sup>; however, other studies have indicated that in TMD patients with myofascial pain, the SEMG values did not reach acceptable levels of sensitivity and specificity for the diagnosis of TMD.<sup>16,17</sup> Nonsignificant differences between electromyographic (EMG) activities of the painful and nonpainful sides have been shown,<sup>18</sup> and there were unclear pain-side-associated SEMG activities in the anterior temporalis and masseter muscles during centric and eccentric maximal voluntary clenching (MVC).<sup>11</sup> Similar uncertainty exists regarding the association between occlusion and TMD,<sup>19–21</sup> which is at least partially owed to the complexity of occlusion, such as how to classify and evaluate a functional occlusion. Enrolling a group of TMD patients with a simple type of occlusal relation—for example, an overerupted third molar—should be helpful in clarifying the association between SEMG activity of jaw muscles and the strength of an interfering occlusal contact (as detected by the T-Scan system), as well as TMD symptoms. A positive association between SEMG activity and the strength of the contact with the occlusal interferences could be taken as a sign of dysfunction of that type of occlusion. Whether such a dysfunction is linked to TMD symptom(s) is an interesting question.

Jaw muscle SEMG activity and occlusal features vary greatly from individual to individual. To diminish such an impact, side differences were considered for comparison in this study.<sup>9,10</sup> Thus, the aim of the present study was to determine whether the side of an overerupted third molar and/or the side exhibiting TMD symptoms had an association with the bilateral distribution of occlusal contact number, occlusal force, or SEMG activity of the anterior temporalis and masseter muscles. The null hypothesis was that neither side would have an association with any of the measured variables.

## Materials and Methods

### Subjects

A total of 19 patients with unilateral TMD symptoms and one unilateral overerupted mandibular third molar aged  $25.26 \pm 4.00$  (mean  $\pm$  SD) years were recruited from the Department of Oral Anatomy and

Physiology and TMD, School of Stomatology, the Fourth Military Medical University, Xi'an, China. This study was conducted in accordance with the Helsinki Declaration. All participants gave their consent to participate in the test. This experiment was approved by the Institutional Review Board of The Fourth Military Medical University. The patients were diagnosed according to the Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD)<sup>22</sup> into the following diagnoses: myofascial pain ( $n = 7$ ); myofascial pain with limited opening ( $n = 8$ ); disc displacement with reduction ( $n = 4$ ); disc displacement without reduction but with limited opening ( $n = 3$ ); disc displacement without reduction and without limited opening ( $n = 10$ ); arthralgia ( $n = 11$ ); osteoarthritis of the temporomandibular joint (TMJ) ( $n = 4$ ); and osteoarthrosis of the TMJ ( $n = 2$ ). The overeruption and occlusal contact features were identified by the author (B.Y.) who analyzed the study casts. The definition of an overerupted third molar was that the mesial marginal ridge was higher than the distal marginal ridge of its neighbor (the second molar of the same arch) and that it had an occlusal contact with the distal part of its opposing maxillary second molar. The distributions of the overerupted third molar and clinical symptoms (including orofacial pain, TMJ sounds, and TMJ locking) are shown in Table 1. Other inclusion criteria for the patients were as follows: permanent dentition and Angle's Class I first molar relationship; and no appearance of malocclusion in the dental arches, such as obvious dental crowding, deep overbite, large overjet, cross bite, and/or open bite in the anterior and/or posterior sections. The exclusion criteria were as follows: known history of bruxism; history of orofacial trauma; tooth restorations or edentulous spaces (except the third molar[s]); obvious periodontal diseases as determined during a clinical examination (by B.Y.); past or ongoing orthodontic treatment or orthognathic surgery; and/or generalized pain and systemic joint disease.

Each patient sat in a chair with a backrest with their feet flat on the floor, head upright, and eyes concentrated on a target placed at a distance of 2 m in front of them. The Frankfort horizontal plane was parallel to the floor. Dental study casts were produced for each subject. Before the experiment, each subject received an explanation of the protocol using the dental casts. All subjects were encouraged to use maximum effort to clench during the experiment. Before engaging in the formal tests, the subjects practiced the designated tasks in front of a mirror under the guidance of an examiner until they successfully performed the task at least five times. The initial and final occlusal positions were visually checked by the examiners during recordings.<sup>12</sup>

**Table 1** Distribution of Overerupted Third Molar, Maximum Mouth Opening, and Side with Temporomandibular Joint (TMJ) Sound, Locking, or Pain

Subject no.	Age (y)	Site of overerupted third molar (FDI)	Side with pain	Side with sound(s)	Side with locking	Maximum mouth opening (mm)	Duration of symptoms
1	24	48	R	R	–	42.8	6 mo
2	31	48	L	L	–	44.4	5–6 d
3	26	48	R	R	–	34.4	12 mo
4	28	48	–	R	R	38.4	12 mo
5	34	48	R	–	–	38.5	3 mo
6	22	48	L	–	–	42.2	12 mo
7	23	38	R	R	R	39.1	4 mo
8	22	38	–	R	–	43.1	36 mo
9	26	38	R	–	–	28.1	3 mo
10	23	38	L	–	–	35.8	1 wk
11	26	38	–	L	L	36.3	60–72 mo
12	26	38	L	–	–	24.2	2 wk
13	21	38	L	L	–	49.5	4 mo
14	18	38	R	R	R	41.6	3 mo
15	26	38	R	R	R	53.5	6 mo
16	20	38	–	L	L	46.4	3 d
17	25	48	R	–	–	51.3	1 wk
18	29	48	R	R	–	33.1	1 mo
19	30	48	R	R	–	35.2	3 mo

L = left side; R = right side. There was no comorbidity related to temporomandibular disorders in all patients.

### Test Procedures and Tasks

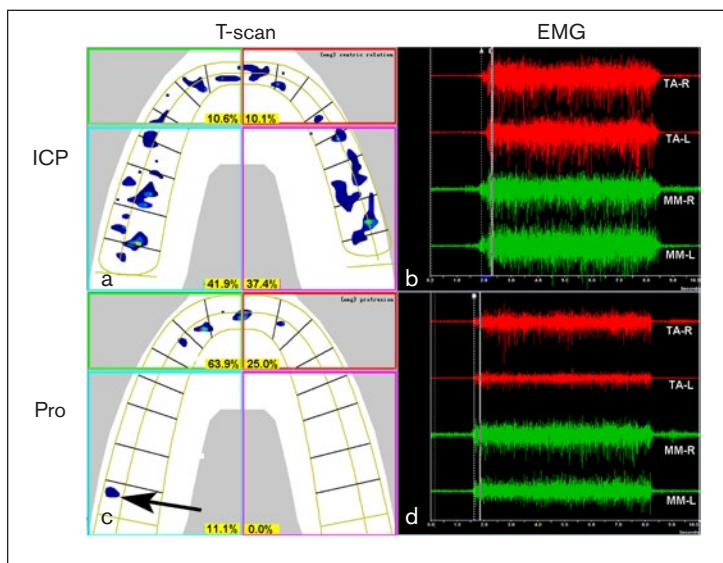
The SEMG activities of the anterior temporalis and masseter muscles were recorded using the Bio-EMG III system (BioRESEARCH Associates), as previously reported.<sup>12</sup> Briefly, the skin was locally prepared with 95% ethyl alcohol. The surface electrodes (BioFLEX; BioRESEARCH Associates) were adhered to the skin bilaterally over the anterior temporalis and masseter muscles. The EMG recordings were performed using self-adhesive surface electrodes. The electrodes were positioned over the palpated main bulk of the contracted muscles, orienting the bipolar electrode axis parallel to the general direction of the fibers of the anterior temporalis and masseter. The reference electrode was placed on the seventh cervical vertebral area, as previously described.<sup>11</sup>

The technical specifications of the Bio-EMG III system were as follows: The analog EMG signal was amplified differentially with a fixed gain of 5,000 within a peak-to-peak input range of  $\pm 1,000 \mu\text{V}$  and digitized with a 16-bit resolution analog-to-digital converter at a 1,000-Hz sampling frequency. The theoretical resolution was  $0.03 \mu\text{V}$  using a differential amplifier with a high common mode rejection ratio (CMRR > 130 dB at 50/60 Hz [either line frequency], differential input impedance  $10^{11} \Omega$ , a maximum signal to noise ratio of  $6.5 \times 10^4$  to 1) and a filtered bandwidth in the frequency range of 20 to 500 Hz (low pass = 6 dB/octave, high pass = 12 dB/octave). An additional 40 dB of band-stop for common 50/60 Hz interference and associated harmonics was available with an intelligent postrecording software digital filter (BioPAK, BioRESEARCH Associates).

The T-Scan III occlusion analysis system was used to record occlusal contacts and bite force values at different sections of the dental arch. For each subject, the force threshold was set according to the instrumental introduction, as previously reported.<sup>12</sup> The number of occlusal contacts was recorded. The relative bite force in a task, defined as the ratio of the level of the test bite force to the maximal level of the bite force in that task, was also calculated. The sampling sections were the anterior and posterior sections, which were automatically divided by the software after setting the anterior to posterior default position in the ratio of 1 to 2.15 separately for the right and left sides of the arch. Sectional arches thus included four sections: anterior right arch; anterior left arch; posterior right arch; and posterior left arch. The four sections constituted the whole arch without any overlap between them. The ratio of the arch sectional bite force to the total force of the arch was termed the sectional force value (SFV).

Two tasks were randomly recorded for each subject (Fig 1): closing of the mouth from the rest position to perform maximal voluntary clenching (MVC) as quickly as possible in the (1) intercuspal position (ICP), labeled as ICP-MVC; and (2) in the protrusive edge-to-edge position, labeled as Pro-MVC. Each task was tested twice. Each recording took approximately 10 seconds, with a 2-minute resting interval between the first task and the repeated task. There was an interval of 5 minutes between different tasks in order to prevent muscle fatigue. All other details are the same as those reported previously.<sup>12</sup>

**Fig 1** Example of the T-Scan/surface electromyographic (EMG) recordings during maximal voluntary clenching (MVC) at the intercuspal position (ICP) and protrusive edge-to-edge position (Pro) from a patient with a mandibular third molar overeruption on the left side. **(a, c)** T-Scan data. The percentages represent the sectional force in the left and right sections of the anterior and posterior arch. The arrow indicates the protrusive posterior contact. **(b, d)** Recording of the surface electromyography. Duration of display was 10 seconds. TA = anterior temporalis; MM = masseter, R = right side, L = left side.



### Data Collection

First, the maximal value of the bite force of the whole arch (ie, 100%-MVC) was identified for each recording of the MVC tasks. Then, by playback of the recording of 100%-MVC on the screen, the sites of the clenching level reaching 50%- and 75%-MVC were located. The values of 100%-, 75%-, and 50%-MVC from the first and the repeated recordings were averaged to represent the character of that subject. The mean values of the SFV, the number of occlusal contacts, and the SEMG value of each recorded muscle from ICP-MVC and Pro-MVC were used for calculation of the differences between sides ( $\Delta$ values). The  $\Delta$ value was defined as the value of the difference in each of the parameters, calculated by the difference of the right side minus the left side. They included  $\Delta$ SFV,  $\Delta$ number of occlusal contacts, and  $\Delta$ value of SEMG activity.

### Statistical Analyses

The power analysis of the sample was estimated using G\*Power 3.1.9.2 software. To show a difference of 1  $\mu$ V, with  $\alpha = 0.05$ , two-tailed, and a power of  $1 - \beta = 98\%$ , 19 patients were required. SPSS 17.0 software was used for the statistical analyses. Two-factor analysis of variance (ANOVA) was used to detect the associations of the two independent variables—the side with TMD symptoms and the side with an overerupted third molar—with the  $\Delta$ values of the number of occlusal contacts, occlusal force, and SEMG activity level. Examinations of interactions were performed for values that showed associations. Student paired *t* test was used for comparison between the overeruption side and the nonovereruption

side and/or the symptomatic side and the nonsymptomatic side. The level of significance was set at  $P < .05$  for all statistical tests.

### Results

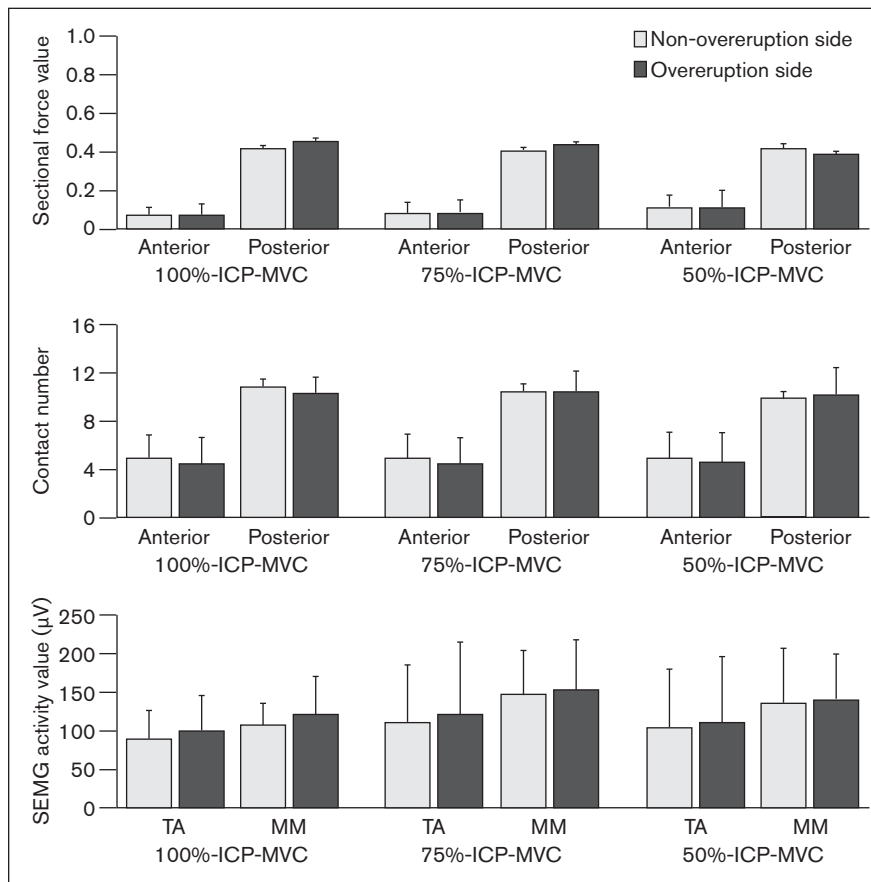
The mean values and standard deviations (SD) of the SFVs, the number of occlusal contacts, and the SEMG values of the bilateral anterior temporalis and masseter muscles obtained from 100%-, 75%-, and 50%-MVC in ICP-MVC and Pro-MVC are presented in Figs 2 to 5.

#### Association Between Symptomatic Side and $\Delta$ Values

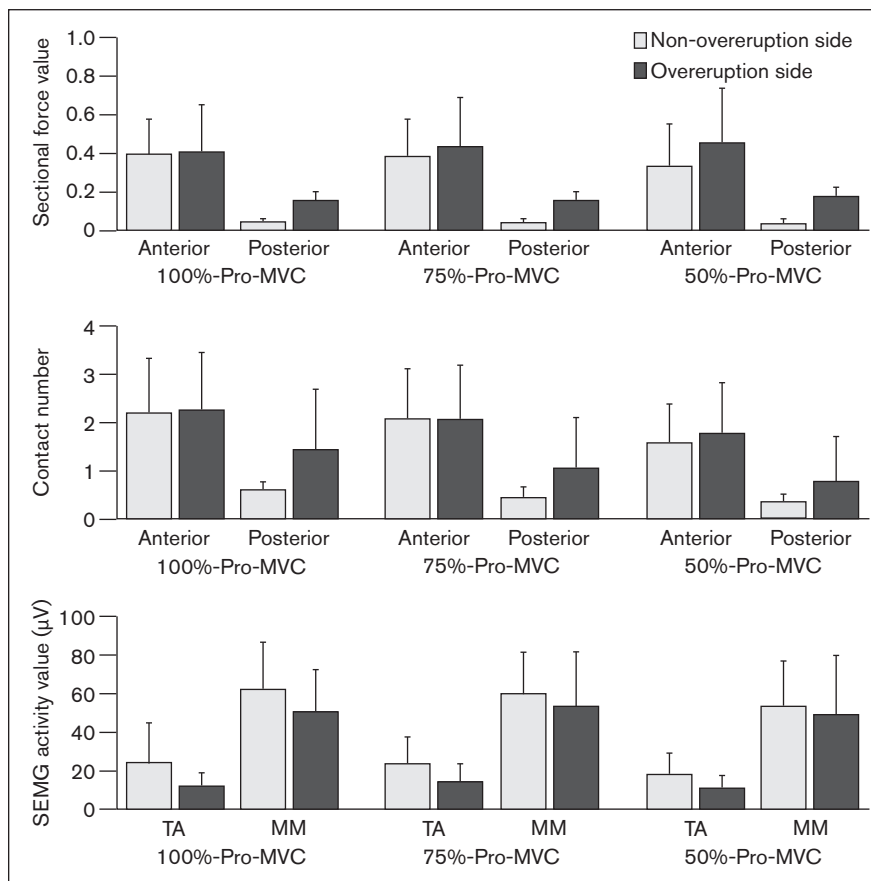
In the 100%-, 75%-, and 50%- of ICP-MVC or Pro-MVC, the symptomatic side did not have any association with the  $\Delta$ SFVs, the  $\Delta$ number of occlusal contacts, or the  $\Delta$ values of SEMG activity of the anterior temporalis and masseter ( $P > .050$ ).

#### Association Between Overeruption Side and $\Delta$ Values

There was no association between the overeruption side and any of the  $\Delta$ values in the 100%-, 75%-, or 50%-ICP-MVC ( $P > .050$ ), nor with the  $\Delta$ SFVs in the anterior arch, the  $\Delta$ number of occlusal contacts in the anterior arch, or the  $\Delta$ values of SEMG activity of the masseter in the 100%-, 75%-, or 50%- Pro-MVC ( $P > .050$ ). There was no association between the overeruption side with the  $\Delta$ number of occlusal contacts in the posterior arch in the 50%-Pro-MVC ( $P > .050$ ).



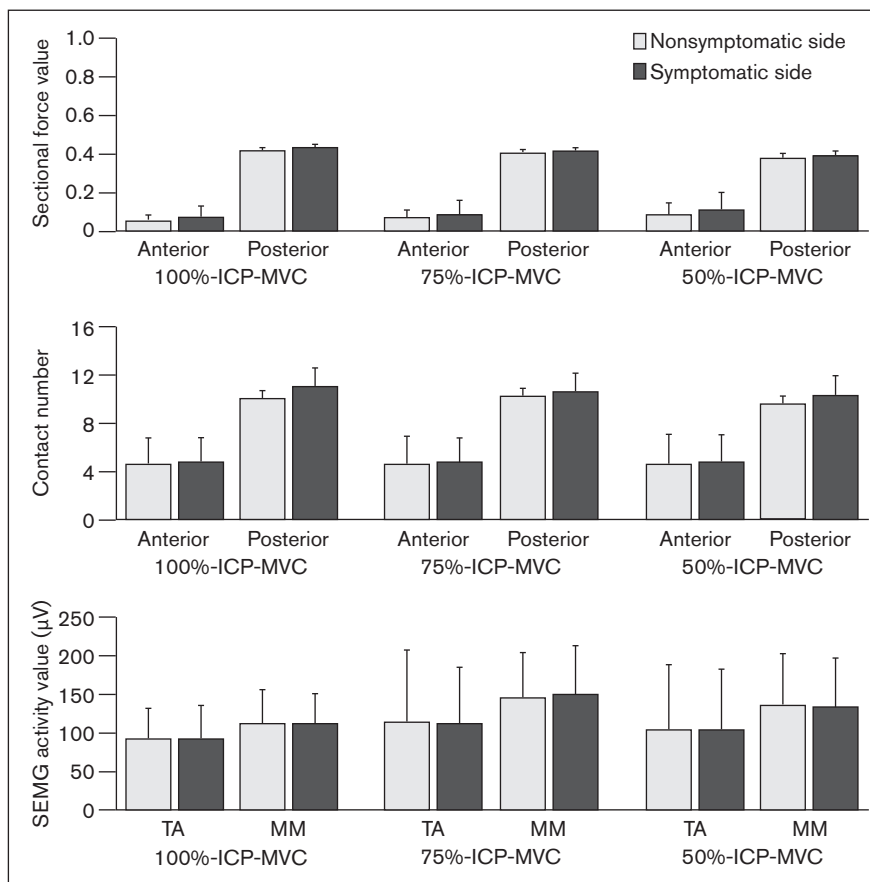
**Fig 2** Graphs showing the means and standard deviations of the sectional force values (SFVs), the number of occlusal contacts, and surface electromyographic (SEMG) activity of the anterior temporalis (TA) and masseter (MM) muscles from the side of third molar overeruption and non-overeruption when performing 100%-, 75%-, and 50%- maximal voluntary clenching (MVC) in the intercuspal position (ICP-MVC).



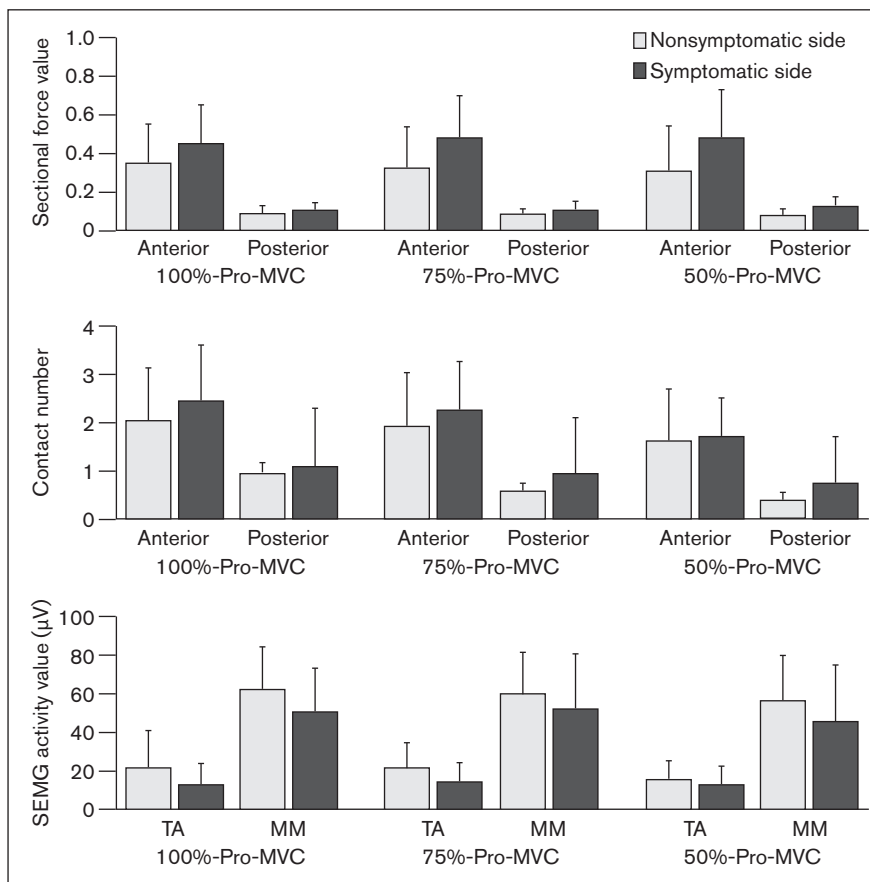
**Fig 3** Graphs showing the means and standard deviations of the sectional force values (SFVs), the number of occlusal contacts, and surface electromyographic (SEMG) activity of the anterior temporalis (TA) and masseter (MM) muscles from the side of third molar overeruption and non-overeruption when performing 100%-, 75%-, and 50%- maximal voluntary clenching (MVC) in the protrusive edge to edge (Pro-MVC) position.



**Fig 4** Graphs showing the means and standard deviations of the sectional force values (SFVs), the number of occlusal contacts, and surface electromyographic (SEMG) activity of the anterior temporalis (TA) and masseter (MM) muscles from the TMD symptomatic side and nonsymptomatic side when performing 100%-, 75%-, and 50%- maximal voluntary clenching (MVC) in the intercusp (ICP-MVC) position.



**Fig 5** Graphs showing the means and standard deviations of the sectional force values (SFVs), the number of occlusal contacts, and surface electromyographic (SEMG) activity of the anterior temporalis (TA) and masseter (MM) muscles from the TMD symptomatic side and nonsymptomatic side when performing 100%-, 75%-, and 50%- maximal voluntary clenching (MVC) in the protrusive edge to edge (Pro-MVC) position.



However, the overeruption side did show associations with the  $\Delta$ SFVs in the posterior arch in the 100%-Pro-MVC ( $F = 10.40, P = .006$ ), 75%-Pro-MVC ( $F = 13.38, P = .002$ ), and 50%-Pro-MVC ( $F = 11.21, P = .004$ ), with the  $\Delta$ values of SEMG activity of the anterior temporalis in the 100%-Pro-MVC ( $F = 9.70, P = .007$ ), 75%-Pro-MVC ( $F = 5.88, P = .028$ ), 50%-Pro-MVC ( $F = 19.52, P = .001$ ), and with the  $\Delta$ number of occlusal contacts in the posterior arch in the 100%-Pro-MVC ( $F = 7.61, P = .015$ ) and 75%-Pro-MVC ( $F = 4.98, P = .041$ ).

### Interaction Between Overeruption Side and Symptomatic Side

Only one interaction between the two factors was found to be significant: the  $\Delta$ value of the anterior temporalis SEMG activity in the 50%-Pro-MVC ( $F = 5.62, P = .032$ ). Further analysis indicated that, when both the symptom(s) and the overeruption were on the left side, the  $\Delta$ SEMG value of the anterior temporalis was  $8.3 \pm 12.2 \mu\text{V}$ . When the symptom(s) were on the left side and the overeruption was on the right side, the  $\Delta$ SEMG value of the anterior temporalis was  $-21.5 \pm 12.7 \mu\text{V}$ . When the symptom(s) were on the right side and the overeruption on the left side, the  $\Delta$ SEMG value of the anterior temporalis was  $0.2 \pm 3.7 \mu\text{V}$ . Finally, when both the symptom(s) and the overeruption were on the right side, the  $\Delta$ SEMG value of the anterior temporalis was  $-8.8 \pm 7.0 \mu\text{V}$ .

### Comparison Between Overeruption Side and Non-Overeruption Side

The Student paired  $t$  test indicated that the SFVs in the posterior arch were higher on the overeruption side than on the non-overeruption side in the 100%-Pro-MVC ( $t = -3.05, P = .007$ ), 75%-Pro-MVC ( $t = -3.07, P = .007$ ), and 50%-Pro-MVC ( $t = -2.55, P = .020$ ). The number of occlusal contacts in the posterior arch was larger on the overeruption side than on the non-overeruption side in the 100%-Pro-MVC ( $t = -3.51, P = .002$ ) and 75%-Pro-MVC ( $t = -2.62, P = .017$ ). The protrusive posterior contact was located at the region of the overerupted third molar (Fig 1). The values of the SEMG activity of the anterior temporalis were lower on the overeruption side than on the non-overeruption side at 100%-Pro-MVC ( $t = 3.00, P = .008$ ), 75%-Pro-MVC ( $t = 2.79, P = .012$ ), and 50%-Pro-MVC ( $t = 3.39, P = .003$ ).

## Discussion

The null hypothesis of the present study was rejected because the data indicated that the interfering occlusal contact of the overerupted third molar was

associated with a difference between sides in the number of occlusal contacts, SFV of the occlusion, and SEMG values in the anterior temporalis during Pro-MVC performed by the TMD patients. Such an association was not found for those values obtained from ICP-MVC, and the symptomatic side did not have such an association except when interacting with the overeruption side, in which case the association was found with the  $\Delta$ value of anterior temporalis SEMG activity at 50%-Pro-MVC.

Dental occlusion in human beings is so complex that it is difficult to provide a functional morphologic classification. Wang and Mehta<sup>23</sup> have pointed out that the cuspal inclines play a role in distributing the occlusal forces in several directions, thus preventing excessive point pressure on the individual tooth involved. Recently, Zhang et al<sup>24</sup> used a three-dimensional finite element model to describe the effect of the size, location, and direction of occlusal loading on both tooth and periodontal stresses. However, there is currently no practical method for assessing multi-directional forces on the dentition. Therefore, the present study focused on the interfering contact caused by the overeruption of a mandibular third molar, a situation that made the diagnosis of a local interfering contact more obvious and able to be made with increased confidence. As expected, the present findings confirmed that there was a forceful occlusal interference during protrusive excursive movements that occurred predominantly at the region of the overerupted third molar.

The edge-to-edge protrusion position is often used for detection of occlusal information and jaw muscle activity studies.<sup>12,25</sup> Although it is not normally included during a masticatory movement, the edge-to-edge position is utilized in daily activities, such as for incising. But in subjects who have an overerupted mandibular third molar, it could be an interference. In this view, MVC is seldom performed at the protrusive edge-to-edge position during normal function, like exaggerated chewing motion and border movements, which are recommended to assess the occlusal function, but it could be helpful for determining the rational occlusal management.<sup>23</sup>

Periodontal proprioceptors provide a feedback effect on jaw elevator muscle activities via the periodontal-trigeminal mesencephalic nucleus-trigeminal motor nucleus circuit.<sup>26</sup> This functional feature illuminates the regularity of the effect of occlusal interference on the SEMG activity of the jaw muscles. There have been reports that indicated that the SEMG activity of the working side of the anterior temporalis and masseter muscles were higher than their synergistic muscles when centric MVC was performed on unilateral occlusal supports.<sup>9</sup> However, the overeruption of the third molar in the present study

did not seem to interfere with the centric occlusal contacts, as there were no signs of any association between overerupted molar and SEMG activity in the centric MVC task. Regarding Pro-MVC, previous reports have indicated that the SEMG activity of the anterior temporalis and masseter muscles obtained from clenching in the protrusive edge-to-edge contact position showed no significant differences between sides in healthy participants.<sup>12</sup> In agreement with these reports, the present data did not disclose any side differences in the SEMG activity of the masseter. However, the data indicated that the non-overeruption side—or the opposite side of the interfering contact—had a higher level of SEMG activity in the anterior temporalis during protrusive clenching at all of the analyzed levels. It has been pointed out that there is a difference in the function of the anterior temporalis and masseter<sup>27</sup> muscles in that the anterior temporalis functions more as a force driver while the masseter functions more as a stabilizer. This difference explains the reported view that during protrusion movements, for example, occlusal load shows a smaller effect on EMG peak activity in the masseter muscle than in the temporalis.<sup>27</sup> Similarly, the current results indicate that the side with a higher level of contact force and a larger number of contacts during protrusive MVC had a lower level of anterior temporalis SEMG activity, but a balanced level of SEMG activity bilaterally in the masseters. This implies that the anterior temporalis contributes less to force but possibly more to stabilization of the jaw during protrusive clenching. The EMG analysis in this study was limited to the anterior temporalis and masseter muscles, with no mention of the involvement of the medial pterygoid muscle, which is also very active during protrusive movement and biting. Whether there is a bilateral difference in the EMG activity of the medial pterygoid muscle in TMD patients and whether the bilateral difference in the anterior temporalis SEMG activity involves coping with the activity of medial pterygoid muscles remains an open question.

When interacted with occlusion, the factor of TMD symptoms showed an association with the  $\Delta$ value of anterior temporalis SEMG activity during 50%-Pro-MVC. Such a limited interaction of the two factors could have occurred by chance because further analysis did not disclose a regular association. The present result suggests that SEMG devices could be used by dentists as a detector for occlusal function, but not for evaluation of TMD, as has been reported in the literature.<sup>17</sup> Thus, the answer to the question of the role of occlusion in TMD remains open.

This study has the following limitations: The T-Scan sensor's thickness was only 60  $\mu\text{m}$ ,<sup>28</sup> and repeated biting on the sensor for 20 to 24 times can

be accomplished without degradation of the sensor force reproduction.<sup>29</sup> Although this study did not reach this many repetitions, some small degradation of occlusal measurements may have occurred. Although it satisfied the power analysis, the sample size was small, since only 19 patients were included. Also, the subjects had not only overeruption of one mandibular third molar, but also TMD, and although two-factor ANOVA was used to detect the associations of the two independent variables (the side with TMD symptoms and the side with overerupted third molar) with the  $\Delta$ values, an asymptomatic group with interferences and a control group without interferences should have been investigated in order to address the aim adequately. This would allow a rigorous testing of the aim.

## Conclusions

The side with an overerupted third molar had an association with the bilateral distribution of the occlusal contact number and force and with the anterior temporalis SEMG activity, but the side with TMD symptoms did not have such an association, although there was a weak interaction of both factors on the anterior temporalis SEMG activity during medium levels of protrusive clenching. A clinical trial of the effects of extraction of the overerupted third molar in patients with and without TMD symptom(s) is warranted to further elucidate whether this altered anterior temporalis activity is associated with a heavy interfering contact and whether and to what degree it contributes to orofacial fatigue-associated pain,<sup>30</sup> a symptom that is linked to dysfunctional jaw muscles often reported among chronic TMD patients.

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