The relationship of bruxism with craniofacial pain and symptoms from the masticatory system in the adult population

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SUMMARY The association of bruxism with craniofacial pain and symptoms of dysfunction of the masticatory system was assessed in a sample of 483 adult subjects, aged 18–75 years and selected from the general population living in the municipality of Segrate, a metropolitan area in northern Italy. Subjects were interviewed by a questionnaire about oral conditions, occurrence of symptoms of masticatory disturbances, craniofacial and neck pain. The overall prevalence of bruxism was 31-4% (95% confidence interval (CI): 27-3–35-5%). At univariate analysis bruxism was significantly associated with craniofacial pain, difficulty in closing the mouth, difficulty in opening the mouth wide or in locking the mouth, temporomandibular joint sounds, pain on movement, a feeling of stiffness or fatigue of the jaws, and neck pain. After adjustment for reciprocal influences and confounding variables, logistic regression analysis disclosed a strong independent association of bruxism with difficulty in closing the mouth (adjusted odds ratio, (OR): 2-84, 95% CI: 1-68–4-48), and a weaker relationship with craniofacial pain (adjusted OR: 1-84, 95% CI: 1-16–2-93) and temporomandibular joint sounds (adjusted OR: 1-64, 95% CI: 1-00–2-69). The findings show that in the general adult population there is a complex connection among bruxism, craniofacial pain and symptoms of masticatory disturbances. Furthermore, they suggest that the most direct relationship of bruxism may be with difficulties in mouth movements, but also an independent association may exist with craniofacial pain and other symptoms of temporomandibular disorder.

KEYWORDS: general population, bruxism, craniofacial pain, temporomandibular disorders

Introduction

Bruxism is a mandibular parafunction common in the general adult population (Agerberg & Bergenholtz, 1989; Agerberg & Inkapol, 1990; Jensen et al., 1993; Matsuka et al., 1996; De Meyer & De Boever, 1997), that has been also recognized to be one of the most destructive dental complaints (Pavone, 1985). This disturbance may determine an impairment of the quality of life (Dao et al., 1994) and also reflect a major masticatory dysfunction, in particular temporomandibular disorders.

Although different studies have examined the association of bruxism with symptoms of temporomandibular disorders and pain (Magnusson & Carlsson, 1978; Moss et al., 1989; Allen et al., 1990; Dao et al., 1994; Moss et al., 1995; Kampe et al., 1996; Molina et al., 1997), however, the findings are not conclusive. Some authors have further suggested that bruxism may be a cause of temporomandibular disorders (Sigaroudi & Knap, 1983; Kampe et al., 1996; Kampe et al., 1997; Glaros et al., 1998; Amemori, 1999), but there are few reliable experimental trials assessing this hypothesis, besides being performed on very small-sized samples (Kampe et al., 1997; Glaros et al., 1998; Amemori, 1999). Caution should be therefore taken in generalizing results, and in the general population a direct causal etiological mechanism might not be found (De Meyer & De Boever, 1997). Moreover, as pointed out by Lobbezoo and Lavigne (1997) in a recent review of the literature, it
might be that bruxism is a temporomandibular disorder itself, possibly coexisting with other signs and symptoms of masticatory disturbances. Indeed, nowadays, not only the effective significance of bruxism in the pathogenesis of temporomandibular dysfunction is controversial, but even its role in the inter-relationships with other symptoms from the masticatory system and craniofacial pain is still far from being exhaustively clarified. Further, because of the lack of population-based surveys, little is known about the epidemiology of these problems in the general population.

The purposes of the present study were to investigate the relationship of bruxism with craniofacial pain and the masticatory symptomatology in a random sample from a general adult population, and to evaluate whether any independent association exists between bruxism and specific symptoms of temporomandibular dysfunction.

Materials and methods

This study is a part of an epidemiological survey conducted in 1995 to investigate the oral health and needs for treatment of the adult population living in the municipality of Segrate (32 877 inhabitants), a metropolitan area in the surroundings of Milan, northern Italy. The study procedure and sampling method have been previously described (Ciancaglini et al., 1999). Briefly, a total of 483 respondent individuals (300 women and 183 men; mean age 44.9 years, s.d. 14.8, range 18–75), drawn from 520 families selected at random from town census lists, participated in the study. The skewness of the ratio of women to men reflected a tendency towards a higher female acceptance to interview (96.8%) in comparison with males (80.3%). Information was obtained from each participating subject by a questionnaire administered by dentists over a personal interview. The dentists were standardized previously during a training course. The answers was evaluated by resubmitting the questionnaire within the following month to a group of 40 patients who reported craniofacial pain were also asked to mark painful sites on sketches of the human face-head (frontal and rear views). The patients’ drawings were then analysed by one examiner who determined locations of pain with the help of transparent templates. In the following analyses two main areas of craniofacial pain were considered, i.e. head and temporomandibular region. In agreement with The American Academy of Orofacial Pain (1996) the temporomandibular region included the muscles of mastication, the pre-auricular area, and the temporomandibular joint. Other facial sites of pain were further grouped together, including the area surrounding the mouth, zygomatic, nasal and ocular regions. Severity and duration of pain and masticatory symptoms were not assessed in this study, and type of bruxism was not classified. Some variables, namely age, sex and loss of (occlusal or frontal) dental units, were considered as potential confounders because previous studies have showed that they might be associated with bruxism and/or masticatory disturbances (e.g. Agerberg & Bergenholtz, 1989; Kirveskari & Alanes, 1985; Pullinger et al., 1993). Reliability of answers was evaluated by resubmitting the questionnaire within the following month to a group of 40 persons randomly chosen from the original sample. For bruxism the percentage of exact agreement was 100%, whereas for masticatory symptoms and pain items ranged from 90 to 100%, with a mean of 97.5%.

Prevalence rates were adjusted to the age and sex distribution of the overall investigated population. Comparisons of proportions between subjects with and without bruxism were performed using the chi-squared test and Fisher’s exact test, when appropriate. The linear trend in age was tested by the one degree freedom chi-squared test for trend. Multiple logistic
regression analysis was further performed, also adjusting for confounding variables, to evaluate the independent association of each symptom of masticatory disturbances and craniofacial pain with bruxism. The odds ratio (OR) and the related 95% confidence interval (CI) were also calculated. Values of \( P < 0.05 \) were considered to indicate statistical significance (two-tailed test). The SPSS 8.0 package for Windows\(^*\) was used for statistical analysis.

**Results**

Bruxism was reported by 152 (31.5%) subjects, and the overall adjusted prevalence was 31.4% (95% CI: 27.3–35.5%). The prevalence was slightly higher in women than men, both in the whole sample and in different age groups, and decreased, although not significantly, with age (Table 1).

Among 161 (33.3%) subjects who suffered from craniofacial pain, 106 (65.8%) had experienced head pain, 75 (46.6%) temporomandibular pain and 16 (9.9%) pain in other facial sites (4 in area surrounding the mouth, 8 in ocular and nasal regions, and 5 in zygomatic region). Multiple craniofacial pain occurred in 36 (22.4%) of the painful subjects, and there was a significant association in experiencing pain in different locations (\( P < 0.05 \)). Table 2 shows the relationship of bruxism with craniofacial pain and neck pain, as resulted at univariate analysis. A significant association was found with craniofacial pain as a whole (\( P < 0.0001 \)), with a ratio of bruxers to non-bruxers of approximately 1:7:1. The association with each of the locations of craniofacial pain and neck pain was significant too (\( P < 0.05 \)).

Table 3 presents the rate of bruxism related to each considered symptom of masticatory disturbances. Univariate analysis showed a significant association of bruxism with difficulty in closing the mouth (\( P < 0.0001 \)), difficulty in opening the mouth wide (\( P < 0.0001 \)), temporomandibular joint sounds (\( P < 0.01 \)), pain on movement (\( P < 0.01 \)), and a feeling of stiffness or fatigue of the jaws (\( P < 0.05 \)). For these symptoms, the ratio bruxers to non-bruxers was 2:5:1, 1:9:1, 1:7:1, 1:9:1 and 1:5:1, respectively.

Logistic regression analyses were then performed to assess the independent relationship of bruxism with craniofacial pain, neck pain and masticatory symptoms, adjusting both for possible reciprocal effects and confounding variables. When considered as a whole,
craniofacial pain was significantly associated with bruxism also at multiple analysis (unadjusted OR: 2.27, 95% CI: 1.50–3.43; adjusted OR: 1.84, 95% CI: 1.16–2.93). Tables 4 and 5 show in detail the results of the logistic regression expressed as ORs of bruxism and their 95% CI. The second column from the left reports the unadjusted ratios for each of the locations of pain (Table 4), and for each of the masticatory symptoms (Table 5). The third column of the tables shows the ORs adjusted for reciprocal influences among locations of pain (Table 4), and among masticatory symptoms (Table 5). Among locations of pain only pain in facial regions close to the mouth maintained an independent association with bruxism, with a ratio of 3.8. Furthermore, this analysis disclosed that the most significant relationship of bruxism was with difficulty in closing the mouth, with a ratio of approximately 2.9, whereas among symptoms characterizing the temporomandibular dysfunction, only temporomandibular joint sounds reached statistical significance, with a ratio of 1.8. It appears from the last column in Tables 4 and 5 that all the previous associations were almost unchanged after further adjustment for the inter-relationships among locations of pain, masticatory symptoms and confounding variables.

### Discussion

Several authors have investigated the association between bruxism and masticatory disturbances (Magnusson & Carlsson, 1978; Sigaroudi & Knap, 1983; Moss et al., 1989; Allen et al., 1990; Dao et al., 1994; Moss et al., 1995; Kampe et al., 1996; Kampe et al., 1997; Molina et al., 1997; Glaros et al., 1998; Amemori, 1999), but understanding of possible relationships is far from being clarified and the debate is nowadays still open. The purpose of the present survey was to evaluate whether in the general adult population any independent relationship exists between bruxism and symptoms from the masticatory system, in particular the ones related to the temporomandibular dysfunction.

We found an overall prevalence of bruxism (31.4%) that is consistent with the trends observed in earlier surveys (e.g. Agerberg & Bergenholtz, 1989; Agerberg & Inkapool, 1990; Jensen et al., 1993; Matsuka et al., 1996). Indeed, our estimate is higher than 20% found by Agerberg and Inkapool (1990) and assumed by De Meyer and De Boever (1997) as mean prevalence in population, but is comparable with the results of Agerberg and Bergenholtz (1989) and Jensen et al. (1993), and also lower than the value obtained by Matsuka et al. (1996). For example, Jensen et al. (1993), studying a random sample from a Danish adult population, found a prevalence of clenching and grinding of teeth of 22 and 15%, respectively, whereas Matsuka et al. (1996) found in a Japan adult population a corresponding prevalence of 30 and 34%, respectively. As in other studies (Wedel & Carlsson, 1986; Agerberg & Bergenholtz, 1989; Allen et al., 1990; Jensen et al., 1993), we observed that bruxism was more prevalent in women than men and decreased with age, although we did not find statistically significant differences. In our series, also the overall prevalence of temporomandibular pain (15.2%), head pain

### Table 3. Relationship of bruxism with symptoms from the masticatory system

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Bruxism (n = 152)</th>
<th>No bruxism (n = 331)</th>
<th>p&lt;sup&gt;†&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of subjects</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Temporomandibular joint sounds</td>
<td>104</td>
<td>46</td>
<td>30.3</td>
</tr>
<tr>
<td>Feeling of stiffness or fatigue of the jaws</td>
<td>110</td>
<td>45</td>
<td>29.6</td>
</tr>
<tr>
<td>Difficulty in opening the mouth wide</td>
<td>98</td>
<td>46</td>
<td>30.3</td>
</tr>
<tr>
<td>or in locking the mouth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luxation</td>
<td>11</td>
<td>6</td>
<td>3.9</td>
</tr>
<tr>
<td>Pain on movement</td>
<td>60</td>
<td>28</td>
<td>18.4</td>
</tr>
<tr>
<td>Difficulty in closing the mouth</td>
<td>86</td>
<td>46</td>
<td>30.3</td>
</tr>
<tr>
<td>Difficulty on mastication</td>
<td>81</td>
<td>30</td>
<td>19.7</td>
</tr>
<tr>
<td>Pain on mastication</td>
<td>70</td>
<td>28</td>
<td>18.4</td>
</tr>
<tr>
<td>Tremors of the jaws in opening the mouth</td>
<td>31</td>
<td>13</td>
<td>8.6</td>
</tr>
</tbody>
</table>

*Statistical significance.
†Chi-squared test or Fisher’s exact test.
have disclosed a significant relationship of bruxism with pain, in particular with facial pain, jaw pain, headache, and neck pain (Magnusson & Carlsson, 1978; Pavone, 1985; Moss et al., 1989; Allen et al., 1990; Moss et al., 1995; Kampe et al., 1997; Molina et al., 1997; Glaros et al., 1998). However, it should be remarked that some of these results could be biased as they did not adjust for possible inter-relationships among different locations of pain. In fact, in our data, univariate analysis showed a significant correlation of bruxism with each of the locations of pain, and the estimated crude risk was 1:59, 1:78, 3:83 and 1:48, for head pain, temporomandibular pain, pain in areas close to the mouth, and neck pain, respectively, but multiple logistic analysis confirmed a significant independent association of bruxism only with pain experienced in areas close to the mouth (adjusted OR: 3:78). Although some caution should be paid in drawing any conclusion, because no clinical confirmation of location of pain was available, these results may be partially not unexpected. In fact, it may

Table 4. Logistic regression analysis of different locations of pain

<table>
<thead>
<tr>
<th>Location of pain</th>
<th>Crude</th>
<th>Adjusted for other locations of pain</th>
<th>Also Adjusted for masticatory symptoms and other confounding variables‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>1:59 (1:02–2:49)*</td>
<td>1:58 (0:87–2:89)</td>
<td>1:32 (0:70–2:50)</td>
</tr>
<tr>
<td>Temporomandibular</td>
<td>1:78 (1:08–2:93)*</td>
<td>1:50 (0:94–2:41)</td>
<td>1:26 (0:75–2:12)</td>
</tr>
<tr>
<td>Neck</td>
<td>1:48 (1:00–2:19)*</td>
<td>1:37 (0:92–2:04)</td>
<td>1:28 (0:84–1:95)</td>
</tr>
</tbody>
</table>

*P < 0:05.
†Odds ratio related to subjects without pain.
‡Age, sex, loss of occlusal dental unit (yes/no), loss of frontal dental units (yes/no).

Table 5. Logistic regression analysis of symptoms from the masticatory system

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Crude</th>
<th>Adjusted for other masticatory symptoms</th>
<th>Also Adjusted for locations of pain and other confounding variables‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporomandibular joint sounds</td>
<td>2:04 (1:31–3:19)**</td>
<td>1:80 (1:09–2:97)*</td>
<td>1:64 (1:00–2:69)*</td>
</tr>
<tr>
<td>Feeling of stiffness or fatigue of the jaws</td>
<td>1:72 (1:11–2:68)*</td>
<td>1:15 (0:68–1:97)</td>
<td>1:10 (0:63–1:89)</td>
</tr>
<tr>
<td>Difficulty in opening the mouth wide or in locking the mouth</td>
<td>2:33 (1:47–3:67)**</td>
<td></td>
<td>1:56 (0:91–2:67)</td>
</tr>
<tr>
<td>Luxation</td>
<td>2:67 (0:67–9:07)</td>
<td>1:44 (0:52–4:04)</td>
<td>1:21 (0:66–2:22)</td>
</tr>
<tr>
<td>Difficulty on mastication</td>
<td>1:35 (0:82–2:22)</td>
<td>0:83 (0:46–1:51)</td>
<td>0:84 (0:63–2:22)</td>
</tr>
<tr>
<td>Pain on mastication</td>
<td>1:55 (0:92–2:62)</td>
<td>0:94 (0:51–1:71)</td>
<td>0:78 (0:45–1:35)</td>
</tr>
<tr>
<td>Tremors of the jaws in opening the mouth</td>
<td>1:63 (0:77–3:41)</td>
<td>1:07 (0:91–1:26)</td>
<td>1:05 (0:94–1:18)</td>
</tr>
</tbody>
</table>

*P < 0:05; **P < 0:01; ***P < 0:001; ****P < 0:0001.
†Odds ratio related to subjects without symptom.
‡Age, sex, loss of occlusal dental unit (yes/no), loss of frontal dental units (yes/no).
be hypothesized that mechanical stimuli associated with a persistent bruxing behaviour may prolong the nociceptive excitability of facial and masticatory muscles, and then sensitize afferent nociceptors. Consequently, the sensitization process can increase pain sensitivity and therefore pre-dispose different locations to experience pain. This effect may be primarily expressed in a pain sensation in areas close to the mouth and further in regions related to the masticatory activity. This hypothesis is supported by some recent experimental trials (Christensen et al., 1996; Arima et al., 1999). Christensen et al. (1996) observed that a prolonged gum chewing and a brief vigorous clenching of the teeth caused in healthy adult subjects some sensitization of muscles nociceptors. Arima et al. (1999) found that in healthy adult men voluntary standardized grinding movements significantly decreased the pain detection thresholds at both masseter muscles.

In our data, logistic regression also showed that in the relationship between bruxism and masticatory disturbances the most relevant independent association was with difficulty of closing the mouth (adjusted OR: 2.84), and this symptom had a sensitivity of 53.5% and a specificity of 73.3%. At this analysis, among other symptoms characterizing temporomandibular disorders only temporomandibular joint sounds showed a significant independent relationship with bruxism (adjusted OR: 1.64). These results, in accordance with previous studies, suggest that bruxism may be harmful to the masticatory system and that a direct relationship may exist with temporomandibular disorders (Kampe et al., 1996; Kampe et al., 1997; De Meyer & De Boever, 1997; Molina et al., 1997; Amemori, 1999), in particular with temporomandibular joint sounds, as also pointed out by Sigaroudi & Knap (1983). Some authors have also suggested a causal role of bruxism in temporomandibular disorders (Sigaroudi & Knap, 1983; Kampe et al., 1996; Kampe et al., 1997; Glaros et al., 1998; Amemori, 1999), but, because of the cross-sectional study design, no final conclusions concerning cause–effect relationship can be drawn here.

Nevertheless, based on our investigation and the above mentioned findings, one can hypothesize that, although there may be several different mechanisms of craniofacial pain and temporomandibular dysfunction, bruxism, inducing prolonged stimuli and activation of mechanical and neuromuscular activity of the masticatory system, might play an etiologic role in the pathogenesis of facial pain and temporomandibular dysfunction. At the same time, our findings further show that this possible relationship might be very complex. It might involve both anatomical structures and neurological pathways, and a mutual self-induction process among bruxism, pain and temporomandibular disorders may be also supposed. A comprehensive functional evaluation of the masticatory system would be therefore advisable in bruxing subjects, and similarly an examination of bruxing behaviour would be advisable in subjects with masticatory disturbances, especially in those referring to difficulties in mouth movements and craniofacial pain.

Further population-based and large longitudinal studies are desirable to better determine the nature and etiology of the relationship among bruxism, craniofacial pain and masticatory disturbances.

References


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