

# Association Between Malocclusion and Temporomandibular Disorders in Orthodontic Patients Before Treatment

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*The association between malocclusion and the prevalence of temporomandibular disorders (TMD) was studied in an orthodontic patient population before orthodontic treatment was started. A total of 305 patients, 232 with general malocclusion and 73 who also had cleft lip or palate, were given a questionnaire about the subjective symptoms of TMD. Clinical examinations for type of malocclusion and TMD signs were also conducted. No significant differences in the prevalence of TMD were observed between the sexes or between the two patient groups. Temporomandibular joint sounds and difficulty of jaw movement were the most common of the TMD signs and symptoms. Open bite, posterior crossbite, and deep bite were the most prevalent types of malocclusion in both groups. Thus, some specific types of malocclusion were significantly associated with the occurrence of TMD.*

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Temporomandibular disorders (TMD) have become a great topic in orthodontics, and in dentistry in general. As a consequence, various studies have been conducted to elucidate the nature of TMD and its causes.<sup>1-5</sup> These studies have described the causes of TMD, such as masticatory muscle problems, chronic traumatic change in the TMJ, internal derangement of the TMJ, and degenerative change of the TMJ components, although TMD are considered multifactorial in nature. These studies have also indicated that malocclusion may be relevant to inducing functional imbalance of the musculature and malposition of the condyle in the TMJ,<sup>6-11</sup> which are further related to the occurrence of TMD<sup>2</sup>. From these considerations it may be speculated that malocclusion is one of the causes of TMD, although previous articles<sup>12,13</sup> have suggested it plays only a limited role. Thus, it is still unclear whether malocclusion is a cause of or only a predisposing factor in TMD.

To answer this question, epidemiologic studies<sup>7-11, 14-18</sup> have been designed extensively. In these studies, the prevalence of TMD was examined in general subjects or patient populations with various types of malocclusion. Varying values were reported, ranging from 35% by Williamson<sup>9</sup> to 71.6% by Nilner and Lassing.<sup>10</sup> It was also indicated that TMD signs are found in all age groups from adolescence to adulthood, although children exhibit lower prevalences than adults.<sup>9-11,14-18</sup> Further, another aspect of TMD as it relates to occlusion has been studied in association with orthodontic treatment.<sup>19-25</sup> There are opposing views on this subject: that orthodontic treatment has no association with TMD<sup>15,21-23</sup> and that orthodontic treatment is responsible for curing or inducing TMD.<sup>8,18-20,24,25</sup>

**Table 1** Summary of Subjects

Patients	Men	Women	Total
Ordinary orthodontic	86	146	232
Cleft lip/palate	33	40	73
Total	119	186	305

However, it has not been confirmed whether specific types of malocclusion are more highly associated with TMD occurrence than others, and such information would be very useful in identifying at-risk patients.

The present study was conducted to investigate the association between malocclusion and the TMD prevalences in orthodontic patients before treatment and further to determine the specific type or types of malocclusion that predispose toward TMD occurrence.

## Materials and Methods

A total of 305 subjects, examined but untreated, were selected from patients at the orthodontic clinic of Osaka University Dental Hospital. These included 232 ordinary orthodontic patients and 73 cleft lip and palate (CLP) patients. Male and female distributions in each group are shown in Table 1.

For each subject, types of malocclusion and subjective symptoms and clinical signs of TMD were evaluated by trained orthodontists according to the following items by means of interview and clinical examination.

### Malocclusion

Type of malocclusion was determined using patient dental casts and classified as follows:

1. Mandibular prognathism—malocclusion with anterior crossbite
2. Maxillary protrusion—malocclusion with overjet greater than 5 mm
3. Posterior crossbite—malocclusion with posterior unilateral or bilateral crossbites
4. Open bite—malocclusion with negative overbite
5. Deep bite—malocclusion with overbite greater than 5 mm
6. Crowding—malocclusion with malposition of teeth

The first three malocclusions are associated with horizontal skeletal discrepancies, the second two

with vertical skeletal discrepancies. Crowding is a result of dentoalveolar discrepancies.

If several types of malocclusion were detected for a subject, all the malocclusions were included during data sampling.

### Subjective Symptoms and Clinical Signs of TMD

Temporomandibular disorders herein include subjective symptoms and clinical signs for TMJ sounds, TMJ pain, muscle tenderness, and difficulty of jaw movement. The subjective symptoms were first recorded on a questionnaire, ie, which symptoms are recognized by the subjects and how troublesome are they? Further, TMD signs were examined during initial orthodontic diagnosis following the methods proposed by Helkimo<sup>26</sup> and Krogh-Poulsen<sup>27</sup>:

1. Temporomandibular joint sounds, including clicking and crepitation, were determined on palpation of both TMJs laterally and posteriorly during opening and closing of the mandible.
2. Temporomandibular pain was examined on palpation of both TMJs from the lateral and posterior sides.
3. Muscle tenderness was determined on palpation of the temporalis, masseter, and medial and lateral pterygoid muscles.
4. Maximum pain-free mouth opening was measured by use of calipers. Difficulty of jaw movement was defined as mandibular opening of 35 mm or less.<sup>17</sup>

These data were summarized as two-way frequency tables and subjected to statistical treatments. Chi-square test was used to evaluate the differences in the TMD frequency between the sexes and between the two patient groups. Further, the association between TMD and malocclusions was investigated by use of independence test for two attributes.

## Results

The prevalence of TMD was 18.5% in men and 19.4% in women (Table 2). No significant differences were observed between both values. The prevalences of TMD in the orthodontic patients and CLP groups were 21.1% (men, 21.9%; women, 21.2%) and 12.3% (men, 12.1%; women, 12.5%), respectively. The values exhibited no significant differences (Table 2). Thus, no significant

Table 2 Prevalence of TMD

Patients	Men		Women		Total	
	n	No. (%)	n	No. (%)	n	No. (%)
Ordinary orthodontic	86	18 (20.9)	146	31 (21.2)	232	49 (21.1)
Cleft lip and/or palate	33	4 (12.1)	40	5 (12.5)	73	9 (12.3)
Total	119	22 (18.5)	186	36 (19.4)	305	58 (19.0)

No significant differences were found between the sexes and between the groups.

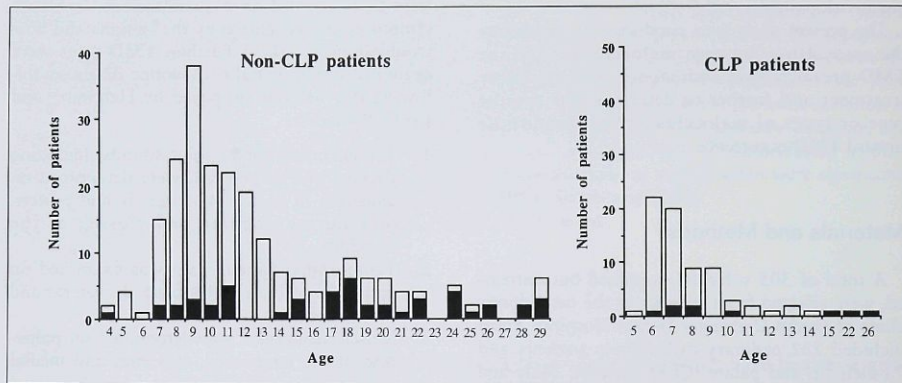


Fig 1 Frequency of TMD by age (years) in patients with and without cleft lip or palate. Unshaded areas represent patients without TMD, shaded areas represent patients with TMD.

differences were observed between the sexes and the groups in this particular patient population.

Figure 1 shows the TMD prevalences for each age in both groups. From 6 to 8 years of age, the prevalence in the CLP group was higher than in the non-CLP group, although the value was approximately 30% at the maximum. For the subsequent ages, the prevalence increased substantially in the non-CLP group; however, because of a lack of CLP subjects at these ages, the prevalences in both groups were not compared.

Table 3 shows the prevalence of TMD for various types of malocclusion. For two subject groups the prevalence of TMD was greater in cases of open bite, posterior crossbite, mandibular prognathism, and deep bite. An interesting finding was that open bite presented the highest values in both groups, reaching almost 50%. The association between TMD and malocclusion type was observed in the whole subject group at the 5%

level of confidence, indicating an existence of specific malocclusion significantly associated with the occurrence of TMD (Table 3).

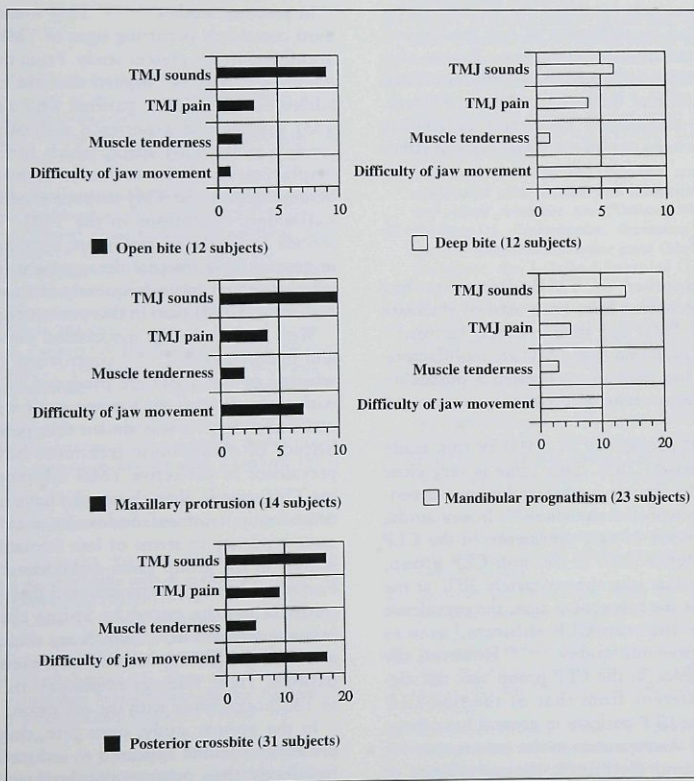
Figure 2 shows the TMD signs and symptoms of open bite, deep bite, maxillary protrusion, mandibular prognathism, and posterior crossbite, which exhibited relatively high prevalences of TMD (Table 3). Temporomandibular joint sounds were observed frequently in cases of open bite, whereas difficulty of jaw movement was prominent in cases of deep bite. Distribution of TMD signs and symptoms for maxillary protrusion was similar to that for mandibular prognathism. The prevalences of TMJ pain and difficulty of jaw movement were substantially higher in cases of posterior crossbite than in mandibular prognathism, while TMJ sounds were slightly more prevalent in mandibular prognathism cases than in posterior crossbite cases.

Distribution of TMD signs and symptoms in

**Table 3** Prevalence of TMD in Each Malocclusion

Malocclusion	Ordinary orthodontic patients		Cleft lip/palate patients		Total*	
	n	No. (%)	n	No. (%)	n	No. (%)
Maxillary protrusion	73	14 (19.2)	2	0	75	14 (18.7)
Mandibular prognathism	65	16 (24.6)	60	7 (11.7)	125	23 (18.4)
Posterior crossbite	64	23 (35.9)	53	8 (15.1)	117	31 (26.5)
Open bite	21	9 (42.9)	6	3 (50.0)	27	12 (44.4)
Deep bite	50	11 (22.0)	8	1 (12.5)	58	12 (20.7)
Crowding	91	18 (19.8)	6	0	97	18 (18.6)

\*Significant association between TMD and malocclusion was found at 5% level of confidence.



**Fig 2** Distribution of TMD signs and symptoms in cases of open bite, deep bite, maxillary protrusion, mandibular prognathism, and posterior crossbite. Numbers on the horizontal axis indicate the number of patients who exhibited TMD signs and symptoms.

**Table 4** Prevalence of TMD Symptoms

Patients	No. Patients with TMD	No. of patients (%) with symptoms			
		TMJ sounds	Muscle tenderness	TMJ pain	Difficulty of jaw movement
Ordinary orthodontic (n = 232)	49	30 (12.9)	8 (3.4)	18 (7.8)	23 (9.6)
Cleft lip/palate (n = 73)	9	6 (8.2)	1 (1.4)	1 (1.4)	6 (8.2)
Total (n = 305)	58	36 (11.8)	9 (3.0)	19 (6.2)	29 (9.5)

patients with TMD is shown in Table 4. In both groups, TMJ sounds exhibited the highest prevalence, followed by difficulty of jaw movement, TMJ pain, and muscle tenderness. It was also found that TMJ sounds were frequently associated with TMJ pain and difficulty of jaw movement. However, no statistically significant association was found between two of the TMD signs in either group.

## Discussion

As the number of TMD diagnoses has increased, approaches have been used to elucidate the nature of TMD and their etiologic factors.<sup>2-11</sup> These studies indicated that TMD are multifactorial in nature, but they also suggested a possibility that malocclusion may affect the occurrence of TMD.

The overall prevalence of TMD in this study was approximately 20%. This value is very close to the result by Brandt,<sup>17</sup> whereas higher frequencies were also reported elsewhere.<sup>9-11</sup> In our study, from 6 to 8 years of age, prevalence in the CLP group was higher than in the non-CLP group, although the value was approximately 30% at the maximum. For the subsequent ages, the prevalence increased in the non-CLP subjects, as was described in previous studies.<sup>9-11,17,18</sup> However, the overall prevalence in the CLP group was not significantly different from that of the non-CLP group. Because CLP patients in general have more severe skeletal discrepancies in the anteroposterior and mediolateral directions, the prevalence of TMD in the CLP subjects would be expected to be much higher than in ordinary orthodontic patients. One explanation for this finding may be the fact

that skeletal discrepancies in adolescent CLP patients have not fully developed and that most of CLP patients undergo an initial examination before the age of 9. Hence, the number of CLP subjects in this study is small at the subsequent ages. These clinical factors may explain why the frequency of TMD in the CLP group was lower than that expected.

It is well known that women are more perceptive of physical changes than men; therefore, the prevalence of TMD in women is greater in general than in men.<sup>17</sup> However, in this study the prevalences of TMD did not differ significantly between the sexes. This finding may be explained by the fact that the present subjects were younger than those in previous studies<sup>7,8,28</sup> and that perceptual differences are not well developed in adolescent patients compared with adults.

In previous studies<sup>9,10,14,28,29</sup> TMJ sounds were the most commonly occurring signs of TMD. This was also found in the present study. From these considerations, it may be implied that the majority of adolescent orthodontic patients who also manifest TMJ sounds first experience malposition of the condyle in the TMJ space, which further induces displacement of the articular disc or internal derangement of the TMJ without producing severe pathologic conditions in the TMJ. Thus, TMJ sounds and reduced maximum opening, resulting in general from internal derangement in the TMJ, were observed more frequently than muscle tenderness and TMJ pain in this patient population.

With respect to the association between TMD and malocclusions,<sup>7-11,14-25</sup> controversy exists as to whether or not TMD are produced in association with malocclusions. In a recent study by Egermark and Thilander,<sup>19</sup> it was shown that persons with a history of orthodontic treatment have a lower prevalence of subjective TMD symptoms, including TMJ sounds, than those who have not received orthodontic treatment. Sadowsky et al<sup>20</sup> found the same tendency in terms of less frequency of TMJ sounds in the group given orthodontic treatment. Further, it has been demonstrated that some TMD patients can be cured by splint therapy<sup>31</sup> and occlusal adjustment,<sup>32,33</sup> which are thought to play a role in eliminating occlusal interferences in such patients. These findings emphasize an association of TMD occurrence with the occlusion.

In the present study, open bite, deep bite, and posterior crossbite appeared to induce TMD more frequently than other malocclusions. Thus, it is suggested that certain types of malocclusion may induce TMD more frequently,<sup>8,9,17,18</sup> and hence not all types of malocclusion always pertain to the

occurrence of TMD. In open bite and deep bite, the amount of anterior guidance is not absolute in protrusive movements of the mandible. For posterior crossbite, occlusal interferences are occasionally induced during lateral movements of the mandible. These occlusal factors may lead to an imbalance of biomechanical stresses in the TMJ.<sup>34</sup> Further, malposition of the condyle and/or articular disc may be produced by mesiodistal and mediolateral shifts of the mandible.<sup>2,3,14,17</sup> These malocclusions, which are more likely to induce malposition of the condyle in the TMJ space, may be more relevant to the occurrence of TMD than others.

Further investigation with cephalometric appraisal for craniofacial morphology in patients with TMD would integrate the morphology with condylar position in the TMJ space.

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## Resumen

Asociación entre la maloclusión y los desórdenes temporomandibulares en pacientes que van a someterse a tratamiento de ortodoncia.

Se estudió la asociación entre la maloclusión y la prevalencia de los desórdenes temporomandibulares (DTM), en una población de pacientes que iba a someterse a tratamiento de ortodoncia. De un total de 305 pacientes, 232 sufrían de maloclusión general y 73 también tenían sus labios fisurados o sus paladares hendidos. Los pacientes tomaron un cuestionario acerca de los síntomas subjetivos de los DTM, y fueron examinados clínicamente para determinar el tipo de maloclusión y los signos relacionados a los DTM. No se observaron diferencias significativas en cuanto a la prevalencia de los DTM, entre los sexos o entre los dos grupos de pacientes. Los signos y síntomas más comunes relacionados a los DTM fueron los sonidos de la articulación temporomandibular y la dificultad para mover la mandíbula. Los tipos más prevalentes de maloclusión en ambos grupos fueron la mordida abierta, la mordida cruzada posterior, y la sobremordida. Por lo tanto, algunos tipos específicos de maloclusión fueron asociados significativamente a la ocurrencia de los DTM.

## Zusammenfassung

Assoziation zwischen Malokklusion und Myoarthropathien des Kausystems bei Orthodontie-Patienten

Die Assoziation zwischen Malokklusion und Prävalenz von Myoarthropathien des Kausystems (MAP) wurde an 305 Orthodontie-Patienten vor Behandlungsbeginn studiert. 233 hatten eine Malokklusion und 73 auch Lippen- oder Gaumenspalten. Die Patienten mussten einen Fragebogen über subjektive MAP-Symptome ausfüllen und wurden klinisch bezüglich Malokklusionsform und MAP-Symptomen untersucht. Es konnten weder zwischen den beiden Patientengruppen noch zwischen den Geschlechtern signifikante Unterschiede in der Prävalenz von Myoarthropathien festgestellt werden. Kiefergelenksgeräusche und eine erschwerte Unterkieferbeweglichkeit waren die häufigsten MAP-Symptome. Als Malokklusionsformen kamen der offene Biss, der seitliche Kreuzbiss und der Tiefbiss am häufigsten vor. Dementsprechend waren einige spezifische Malokklusionsformen mit dem Vorliegen von MAP-Symptomen signifikant assoziiert.