

# Clinical evaluation of temporomandibular joint disorders (TMD) in patients treated with chin cup

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**I**nternal derangement of the temporomandibular joint (TMJ) may be related to some types of malocclusion, such as large overjet and CO-CR slide, posterior crossbite, severe anterior crowding with deep overbite, skeletal anterior openbite, or asymmetrical mandibular morphology.<sup>1,2</sup> TMJ derangements may contribute to the development of retrognathia,<sup>3</sup> while TMD may contribute to horizontal facial deficiencies in addition to a shorter cranial base and pharynx.<sup>4</sup>

Among orthodontists, it is generally understood that the causal relationship between malocclusion and TMD is relatively weak<sup>1</sup> and that orthodontic treatment does not necessarily cause TMD.<sup>5,6</sup> Anterior displacement of the disc is the most commonly encountered type of internal derangement. Posterior displacement of the condyle, which can be induced by chin

cup therapy, may cause anterior disc displacement; this same phenomenon is observed in adverse anterior guidance and mechanotherapy inducing posterior displacement of the condyle.<sup>7</sup>

We still lack information on the incidence of TMD in patients treated with chin cup therapy.<sup>8-11</sup> This study aims to evaluate the incidence and types of TMD during and after active chin cup treatment, and to study the effect of retreatment in TMD cases after chin cup therapy, statically and functionally.

## Materials and methods

Questionnaires were sent to 160 patients (48 males and 112 females, mean age at initial records 10 years 1 month) who underwent chin cup therapy with or without a lingual arch appliance at the Department of Orthodontics, Matsumoto Dental College Hospital, from 1985

## Abstract

The purpose of this manuscript was twofold: (1) to provide more information on the incidence of temporomandibular joint disorders (TMD) in chin cup-treated patients during and after active treatment; and (2) to evaluate results of functional analysis for one orthodontically treated chin cup patient with temporomandibular joint (TMJ) pain and difficulty of maximum mouth opening. Eighty-six out of a total of 160 chin cup patients responded to our questionnaire and were checked for pain, clicking, and maximum mouth opening. Twenty-eight of the chin cup subjects showed one or more symptom(s) of TMD. Spontaneous pain was found most often during active treatment but clicking (sound) occurred more often during the retention phase. One retreated patient showed remarkable improvement of TMD symptoms.

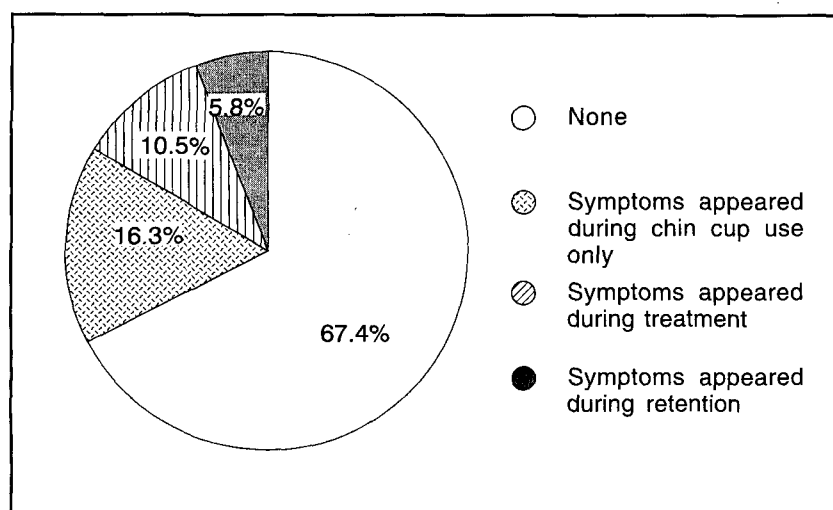
## Key Words

Chin cup appliance • Skeletal Class III • TMD • Functional analysis

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**Figure 1**  
**Incidence of TMD symptoms**

to 1995. Correction of the anterior crossbite and acceptable posterior occlusion had been obtained and chin cup treatment discontinued in all subjects. Eighty-six patients responded to the questionnaire, which was designed to determine the presence of TMD signs and symptoms. Fifty-two patients were checked through the questionnaire only. Thirty-four patients also presented for a chairside examination (pain, clicking, and difficulty of maximum mouth opening); tenderness or palpation in the masticatory muscles were not included in the exam. Seventy-four patients (22 males and 52 females, mean age 15 years, range 10 to 25 years) did not respond to the questionnaire.

The chin cup therapy period ranged from 6 months to 4 years, and the time of wear ranged from 7 to 14 hours per day. Force of 400 to 500 gm was delivered in the direction of the condyle.

### Results

No signs or symptoms of TMD were found in 67% (58 of 86) of the patients. Evidence of TMD was found in 16% of the patients (14 of 86) during chin cup use; in 10% (9 of 86) during active treatment; and 6% (5 of 86) after active treatment (Figure 1). In all, 28 patients (5 males, 23 females, mean age 17 years, range 10 to 25 years) had one or more symptoms of TMD. Nine of 28 patients had two or three symptoms during active treatment; three had symptoms associated with disturbance of mouth opening. Spontaneous TMJ pain occurred most often during active treatment, while clicking was less frequent, with the same incidence observed both during and after active treatment (Figure 2). The 58 patients without evidence of TMD (21 males, 37 females, mean age 14 years, range 7 to 24 years) wore the chin cup in a similar

manner to the 28 patients with TMD.

Four patients (all females) agreed to undergo functional analysis. Three demonstrated a 1 to 2 mm midline shift of the mandible with myofascial pain dysfunction (MPD) syndrome. The fourth patient had impacted third molars, which were found to be the cause of the TMJ pain.

One patient, KY, agreed to undergo follow-up orthodontic treatment for occlusal interference of the second molars, TMJ muscular pain, and difficulty of mouth opening. Muscle-relaxation-splint therapy (flat plane) during sleep was initiated to relieve the TMJ pain. After follow-up orthodontic treatment with an edgewise appliance, the pain disappeared and acceptable static and functional posterior occlusion was obtained. Acceptable anterior and lateral movements of the mandible were also gained.

### Discussion

The prevalence of Class III malocclusion is 1% to 1.6 % in American children and adolescents and 3.9% in the same age group in Japan. The prevalence of anterior crossbite is reported to be about 30% of orthodontic patients visiting clinics in Japan. There are, however, few data on the proportion of true skeletal Class III malocclusions. The data (not published) from our clinic (Matsumoto Dental College Hospital) indicate a 20% incidence of true skeletal Class III malocclusion with or without anterior forced displacement of the mandible. Surgery was required in 5% of such cases, while 10% were true functional (pseudo) Class III malocclusion. The success of clinical orthopedic treatment depends on the dominant morphologic pattern. Six to 12 months of chin cup wear may correct not only the anterior crossbite, but may also ameliorate a true skeletal Class III profile.<sup>13</sup> One risk of chin cup therapy is posterior displacement of the condyle to the glenoid fossa, which may cause anterior dislocation of the articular disc with clicking during mandibular movement.

In the present study, 28 of the 86 chin cup patients who agreed to the screening examination exhibited some type of TMD during or after chin cup therapy. TMJ pain was the most significant symptom during active treatment. During correction of the anterior crossbite, the posterior occlusion remained open due to unstable mandibular position, which may in turn have caused muscular dysfunction with concomitant TMJ pain. Fortunately, correction of anterior crossbite with acceptable posterior oc-

clusion was obtainable within 6 months or so after chin cup therapy. In the present study, TMJ sound was a common occurrence during the retention phase, although TMJ pain decreased dramatically during that time.

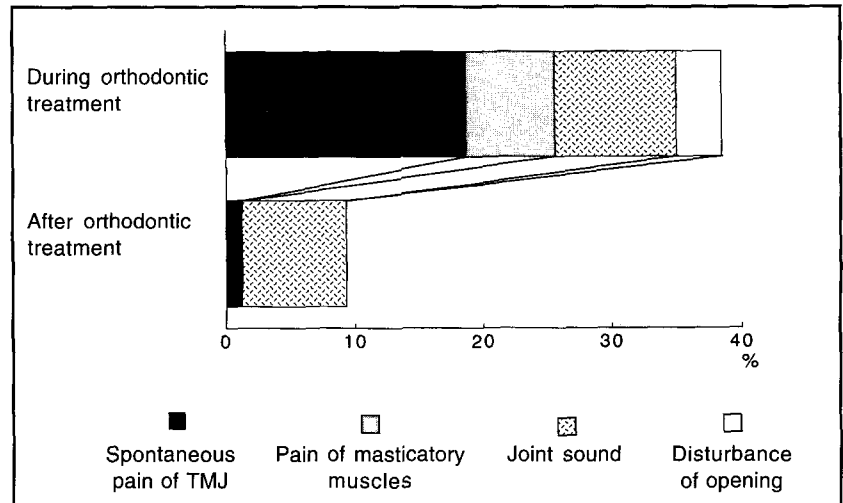
Mukaiyama<sup>8</sup> reported that the incidence of asymptomatic TMD between untreated and chin cup-treated anterior crossbite was 38% and 47%, respectively, although the difference between the two groups was not statistically significant. Gavakos and Witt,<sup>9</sup> using the Helkimo Index, found no statistical difference for the incidence of TMD between chin cup-treated and untreated skeletal Class III groups. Mild dysfunction (1 to 4 points of the Helkimo Index) was observed in about 67% of chin cup subjects and 73% of untreated subjects ( $n = 30$  in both groups). Dibbets and van der Weele<sup>10</sup> indicated that none of the removable appliances, including Begg mechanics and chin cups, should be considered causal factors for the signs and symptoms of TMD.

Sumori<sup>16</sup> reported that 17 of 112 patients (15%) presented with TMD during chin cup treatment. Furthermore, 13 of the 17 showed symptoms of TMJ after adolescence. TMD disappeared when the chin cup treatment period was either shortened or stopped all together, as well as when force was decreased.

In the present study, 28 (18%) of 160 chin cup patients, including 74 nonresponding patients (who were checked on the protocols with no symptoms of TMD during or after the retention period) had some TMD and clicking during retention. At present, our findings indicate that there is little relation between chin cup use and the incidence of TMD. The incidence of TMD in the general population is reported to be 10% to 25%, or 35% to 72% in children and youth. Keeling et al.<sup>1</sup> also found that TMJ sounds were present in 10% of 344 children.

Through follow-up orthodontic treatment, the painful muscular dysfunction experienced by patient KY was relieved. At the same time, difficulty of mouth opening and occlusal disturbance associated with tongue thrust was improved. In addition, limited mandibular movement and muscular dysfunction were corrected.

There are several conservative treatments for TMD, but orthodontic treatment is one of the best approaches to correct functional dental malocclusion. Furthermore, the 28 chin cup patients with TMD in the present study showed a tendency for unilateral posterior crossbite, asymmetrical mandible dislocation associated



**Figure 2**

with a midline shift, impacted third molars, and relapse of anterior segments. Moreover, a skeletal Class III pattern presents a more asymmetrical morphology of the condyle and temporomandibular joint than do skeletal Class I and II patterns.<sup>14</sup> Solberg et al.<sup>15</sup> found that Class II and Class III malocclusions were associated with longer histories of condyle deformation, which suggests that longer exposure to malocclusion may result in more extensive TMJ damage. Thus, early orthodontic or orthopedic treatment may be the first priority to decrease the incidence of TMD.<sup>5</sup> The causes of TMD in our 28 chin cup patients seem to be multifarious.

In conclusion, there was little relation between chin cup treatment and TMD. The successful follow-up treatment of the chin cup-treated patient, KY, for myofascial pain dysfunction, suggests the efficacy of orthodontic treatment over use of the appliance.

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**Figure 2**

**Change in incidence of symptoms during and after active orthodontic treatment. Characteristics of nine patients with two or more symptoms of TMD were as follows. During orthodontic tooth movement: TMJ pain + muscular pain = 4 patients; TMJ pain + sound or muscular pain + sound = 2 patients; three symptoms = 3 patients. After orthodontic treatment: TMJ pain + sound = 1 patient.**

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