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# Effectiveness of exercise therapy in patients with myofascial pain dysfunction syndrome

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**SUMMARY Twenty consecutive patients suffering from myofascial pain dysfunction (MPD) were assigned to a waiting-list, serving as a no-treatment control period. Inclusion criteria were: (i) pain in the temporomandibular region for at least 3 months, (ii) no evidence of internal derangement or osteoarthritis and (iii) symptoms of postural dysfunction. Treatment consisted of active and passive jaw movement exercises, correction of body posture and relaxation techniques. The following main outcome measures were evaluated: (i) pain at rest, (ii) pain at stress, (iii) impairment, (iv) mouth opening at base-line, before and after treatment and at 6-month follow-up. All patients completed the study and no adverse effects occurred. During control period no significant changes occurred. After treatment six patients had no pain at all (chi-square: $P < 0{\cdot}01$) and seven patients experienced no impairment (chi-square: $P < 0{\cdot}005$). Pain at stress, impairment and incisal edge clearance improved significantly (Wilcoxon test $P < 0{\cdot}001$). This result did not change until follow up, except pain at stress, which further improved significantly (Wilcoxon test $P < 0{\cdot}03$). At follow up 16 patients experienced no pain at all, 13 patients were not impaired and only three patients had a restricted mouth opening, in contrast to 12 before treatment (chi-square test $P < 0{\cdot}001$). Conclusion: Exercise therapy seems to be useful in the treatment of MPD Syndrome.**

**KEYWORDS: craniomandibular disorder, temporomandibular disorder, physiotherapy, pain**

## Introduction

Symptoms of craniomandibular disorders (CMD) are common in the general population. Such symptoms, like pain in the temporomandibular joint and masticatory muscles, restricted mouth opening and joint noises, occur in 20–85% of the population (Grosfeld *et al*., 1985; Hiltunen *et al*., 1995; Conti *et al*., 1996; Wanman, 1996; Ciancaglini *et al*., 1999). About 5–6% of the population report clinically significant tempero-mandibular disorder (TMD)-related jaw pain (Goulet *et al*., 1995; Conti *et al*., 1996).

Several factors have been identified to trigger CMD, such as occlusal interference (Olsson & Lindqvist, 1992), hyperactivity of the temporal and masseter muscle (Gervais *et al*., 1989), bruxism (Cooper & Cooper, 1991) and stress (Flor *et al*., 1991). Additionally postural abnormalities have an influence on the development and perpetuation of CMD, too. The incidence of neck disorders (Clark *et al*., 1987) and postural abnormalities (Nicolakis *et al*., 2000) is increased in CMD patients, and patients suffering from neck disorders reveal a higher frequency of CMD symptoms (Carossa *et al*., 1993). Moreover, in CMD patients with sensitive areas in the head, neck and/or shoulders a negative treatment outcome is more frequent (De Leeuw *et al*., 1994). It seems, that CMD with a myogenous involvement is not a local disorder of the stomatognathic system. Consequently, the upper quarter, including the stomatognathic system, cervical spine and shoulder girdle, should be included into the treatment (De Wijer *et al*., 1996).

This demand is met by exercise therapy. It has been used for a long time to treat musculo-skeletal disorders, and is effective in the treatment of neck disorders

(Taimela *et al*., 2000). Additionally, it has been claimed to be effective in the treatment of CMD. However, because of methodological flaws, its effectiveness has not been proven yet. Main problems in the existing studies were: (i) exercise therapy was administered together with other treatments (Schulte, 1972; Trott & Goss, 1978; Hall, 1984; Clark *et al*., 1988; Kirk-Ws & Calabrese, 1989; Garefis *et al*., 1994), (ii) no control group existed (Schulte, 1972; Hall, 1984; Clark *et al*., 1988; Tegelberg & Kopp, 1988; Garefis *et al*., 1994), (iii) lack in defining which subgroup of CMD was treated (Schulte, 1972; Hall, 1984; Clark *et al*., 1988; Tegelberg & Kopp, 1988; Garefis *et al*., 1994) and (iv) the study population was too small (Eisen *et al*., 1984; Trott & Goss, 1978; Tegelberg & Kopp, 1988).

This study aimed at evaluating a treatment protocol including active and passive jaw movement, correction of body posture and relaxation techniques.

## Materials and methods

Twenty consecutive subjects consulting the CMD service at the Department of Dentistry, University of Vienna, participated in this study. Patients were selected if they were willing to participate in the study, and if they met all of the following criteria: (i) diagnostic criteria in accordance with the diagnosis myofascial pain dysfunction (MPD) (Eversole & Machado, 1985), (ii) symptoms lasting at least for 3 months, (iii) pain in the temporomandibular region, (iv) no clinical and radiological evidence of internal derangement or osteoarthritis, and (v) evidence of postural dysfunction. After patients gave consent to participate in the study they were referred to the outpatient clinic for Physical Medicine and Rehabilitation, of the University of Vienna. The same physiatrist examined all subjects in a standardized manner. After this examination, all patients were assigned to a waiting list for exercise therapy, serving as a no-treatment control period, according to a before–after trial study design. Time on waiting list was determined by the availability of treatment.

The outcome measures were

**1** Pain at rest and stress was measured with a 100-mm-long visual analogue scale (VAS). The extremes were labelled 'no pain' and 'worst possible pain'.

**2** Impairment: Patients were instructed to rate their overall experienced impairment in daily life activities with a VAS (100 mm). The extremes were labelled 'no impairment' and 'worst possible impairment'.

**3** Incisal edge clearance was measured in mm (mouth opening). Patients were asked to open their mouth as wide as possible. Then the distance between the first right incisal of the upper and lower jaw was measured with a slide gauge in mm.

**4** Perceived improvement of jaw pain in contrast to the condition at baseline examination was measured on a seven-point scale (excellent, distinct, moderate improvement, equal, moderate, distinct, severe deterioration).

**5** Perceived improvement of jaw function in contrast to the condition at base-line examination was measured on a seven-point scale (excellent, distinct, moderate improvement, equal, moderate, distinct, severe deterioration).

Measures 1–3 were recorded at base-line, immediately before, immediately after, and 6 months after exercise therapy, measures 4 and 5 only at the second, third and final examination.

### *Exercise therapy*

The number of treatments was adapted individually for the need of each patient, and was withdrawn if no further improvement was detectable. Each patient was treated at least five times. Each treatment session lasted 30 min.

Exercise therapy included massage of painful muscles, muscle stretching, gentle isometric tension exercises against resistance, guided opening and closing movements, manual joint distraction, disc/condyle mobilization, correction of body posture, and relaxation techniques. The later consisted of deep breathing and contrasting muscle tension and muscle relaxation exercises. Each patient learned a physical training programme for self administration, including some of the above mentioned exercises for the stomatognathic system, training of body posture and relaxation techniques.

Usually two treatments per week were administered, only the last treatments were given at intervals of 1 to 2 weeks, to control the training program for selfadministration.

## Statistical methods

According to a before–after trial, the time on the waiting list served as control period for the treatment period. Changes of all numerical parameters (pain at rest, pain at stress, impairment of quality of life, incisal edge clearance) were normalized for daily changes for these two periods, as time on the waiting list and treatment time were different. Differences between these normalized data were analysed with the *t*-test for paired samples. Additionally a multivariate analyses of variance (MANOVA) was used to determine differences of longitudinal changes of these data and a Wilcoxon test was applied to test for significant MANOVA effects.

Descriptive data were analysed by the chi-square test (perceived improvement of jaw pain, jaw function, joint clicking). For statistical evaluation of perceived improvement of jaw pain and jaw function the seven-point scale was reduced to a three-point scale, improvement (excellent, distinct improvement), no change (moderate, no improvement, moderate deterioration), and worse (distinct, severe deterioration).

## Results

A total of 16 female and four male patients participated in this study (mean age 34·5 ± 11·3). Patients experienced symptoms of CMD for a mean of 1·2 (range: 0·3–5) years. Mean duration on waiting list was 17·4 (range: 5–69) days, mean duration of treatment period 51·2 (range: 25–88) days. Patients received a mean of 10·8 (range: 5–16) treatments. All patients completed the treatment. No adverse effects occurred.

### *Pain*

At base-line all patients reported pain on stress, seven patients experienced also pain during rest.

During control period no significant changes occurred, nor did the number of patients change who experienced no pain (Table 1). Three patients reported a distinct and six patients reported a moderate improvement of pain, another two a moderate deterioration (Fig. 1). After treatment daily improvement of pain at stress was significantly higher than before treatment, whereas improvement of pain at rest did not reach the level of significance (Table 2). A MANOVA analysis of pain revealed a significant reduction of pain (Pain at rest: MANOVA $F = 8{\cdot}1$, Wilcoxon test: $Z = -2{\cdot}4$, $P < 0{\cdot}02$; Pain at stress: MANOVA $F = 119{\cdot}7$ Wilcoxon test: $Z = -3{\cdot}9$, $P < 0{\cdot}001$)(Fig. 3, Table 1). Six patients experienced no pain at all (chi-square: Pearson 7·1, $P < 0{\cdot}01$), and 15 patients felt no pain during rest (Table 1). 95% of the patients reported an excellent or distinct improvement of pain, no deterioration occurred (Fig. 1, Chi-square: Pearson 25·9, $P < 0{\cdot}001$). At follow up, pain at stress improved further significantly (MANOVA $F = 10{\cdot}6$, Wilcoxon test: $Z = -2{\cdot}2$, $P < 0{\cdot}03$) (Fig. 3, Table 1). The number of patients without pain at rest increased to 17, and 16 patients had no pain at all (chi-square: Pearson 10·1, $P = 0{\cdot}001$). Still 95% experienced an improvement of pain (Fig. 1).

### *Impairment*

At base-line all patients experienced a distinct impairment, which decreased slightly during control period. Consequently two patients reported a distinct improvement (Fig. 2). Daily changes of impairment were

**Table 1.** Median (25 and 75% percentile) incisal edge clearance, pain and impairment ratings. A MANOVA was used to identify significant changes between base-line and pre-treatment investigation, between pre- and post-treatment investigation and between post-treatment investigation and 6 months control

| | Base-line ($n = 20$) | Before treatment ($n = 20$) | After treatment ($n = 20$) | 6-month follow up ($n = 19$) |
|---|---|---|---|---|
| VAS at rest | 0·0 (0·0–48·0) | 0·0 (0·0–26·0) | 0·0 (0·0–2·0)[a] | 0·0 (0·0–0·0) |
| No pain at rest | 13 | 13 | 15 | 17 |
| VAS at stress | 65·0 (53·0–81·0) | 62·0 (48·0–74·0) | 11·0 (0·0–21·0)[b] | 0·0 (0·0–0·0)[c] |
| No pain at stress | 0 | 0 | 6[d] | 16[e] |
| Impairment | 76·0 (56·0–85·0) | 73·0 (65·0–83·0) | 11·0 (0·0–29·0)[f] | 0·0 (0·0–15·0) |
| No impairment | 0 | 0 | 7[g] | 13 |
| Incisal edge clearance | 30·0 (23·0–42·0) | 30·0 (26·0–45·0) | 44·0 (40·0–50·0)[h] | 45·0 (40·0–48·0) |
| Impaired incisal edge clearance | 12 | 12 | 2[i] | 3 |

[a]MANOVA $F = 8{\cdot}1$; Wilcoxon test: $Z = -2{\cdot}4$; $P < 0{\cdot}02$; [b]MANOVA $F = 119{\cdot}7$; Wilcoxon test: $Z$ 3·9; $P < 0{\cdot}001$; [c]MANOVA $F = 10{\cdot}6$; Wilcoxon test: $Z = -2{\cdot}2$; $P < 0{\cdot}03$; [d]Chi-square test: Pearson 7·1: $P < 0{\cdot}01$; [e]Chi-square test: Pearson 10·1: $P = 0{\cdot}001$; [f] MANOVA $F = 126{\cdot}0$; Wilcoxon test: $Z = -3{\cdot}9$; $P < 0{\cdot}001$; [g]Chi-square test: Pearson 8·5: $P < 0{\cdot}005$; [h]MANOVA $F = 31{\cdot}2$; Wilcoxon test: $Z = -3{\cdot}8$; $P < 0{\cdot}001$; [i]Chi-square test: Pearson 11·0: $P = 0{\cdot}001$.

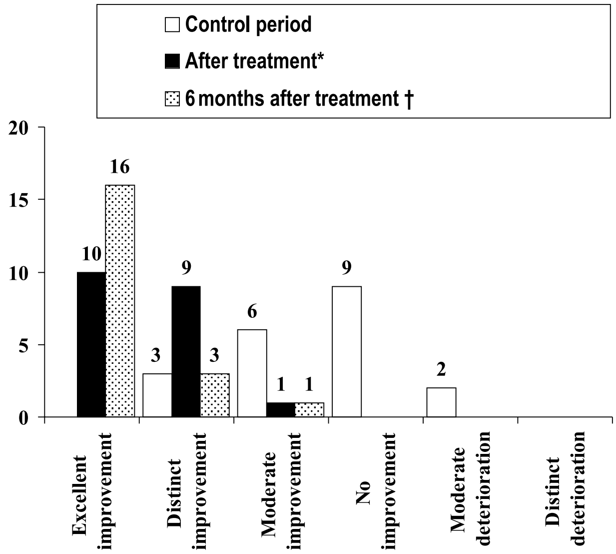



**Fig. 1.** Influence of treatment on perceived improvement of jaw pain. *Difference between control period and treatment period Chi-square test: Pearson 25·9: $P < 0{\cdot}001$; †difference between treatment period and follow-up, chi-square test: Pearson 0·00: $P = 1{\cdot}0$).

**Table 2.** Effects of treatment on pain, impairment and incisal edge clearance. Values represent daily changes (mean ± s.d.)

| | Control period | Treatment period | Paired samples *t*-test |
|---|---|---|---|
| Pain at rest | –0·08 ± 0·39 | –0·25 ± 0·51 | $t = 1{\cdot}0$; $P > 0{\cdot}1$ |
| Pain at stress | –0·25 ± 1·09 | –1·11 ± 0·82 | $t = 2{\cdot}7$; $P < 0{\cdot}02$ |
| Impairment | –0·23 ± 0·64 | –1·26 ± 0·86 | $t = 4{\cdot}1$; $P = 0{\cdot}001$ |
| Incisal edge clearance | 0·06 ± 0·16 | 0·26 ± 0·29 | $t = -3{\cdot}1$; $P < 0{\cdot}01$ |

significantly greater for treatment than for no treatment period (Table 2). The MANOVA revealed also a significant reduction of impairment (Fig. 3, Table 1). Ninety percent of the patients reported an excellent or distinct improvement (Fig. 2) and seven patients experienced no impairment (chi-square: Pearson 8·5, $P < 0{\cdot}005$). At follow up a not significant improvement of the impairment level occurred, 90% of the patients experienced a reduction of impairment (Fig. 2). Thirteen patients reported no impairment at all.

### *Incisal edge clearance*

Twelve patients had an impaired mouth opening (incisal edge clearance < 35 mm) at base-line and after control period. This number decreased to two patients

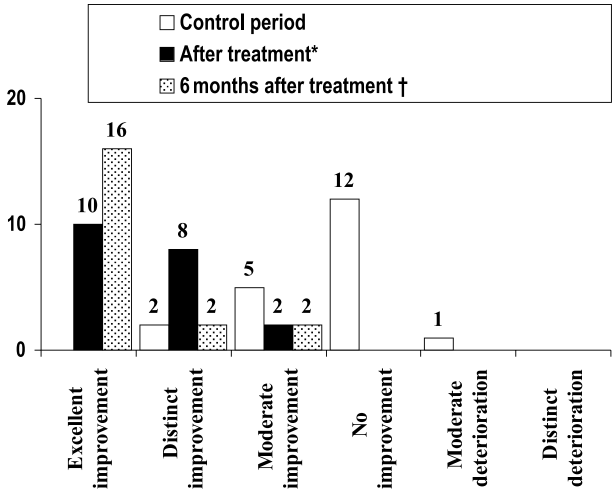


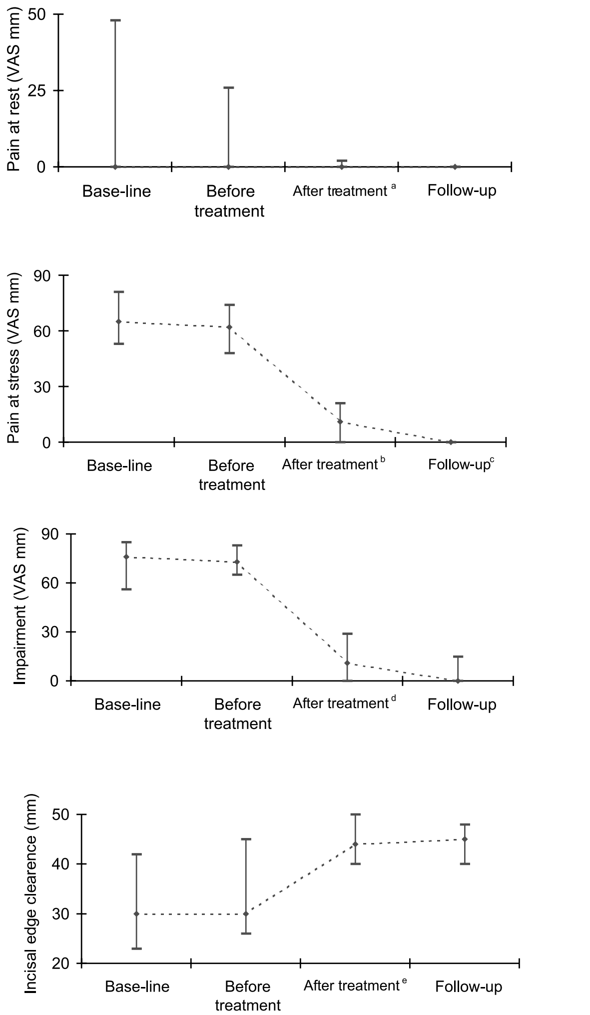

**Fig. 2.** Influence of treatment on perceived improvement of jaw function. *Difference between control period and treatment period, chi-square test: Pearson 25·6: $P < 0{\cdot}001$; †difference between treatment period and follow-up chi-square test: Pearson 0·00: $P = 1{\cdot}0$).

(chi-square: Pearson 11·0, $P = 0{\cdot}001$) after treatment. The MANOVA and daily changes of incisal edge clearance revealed a significant improvement (Tables 1 and 2; Fig. 3). This result did not change until follow up.

At the 6-month follow-up, one patient was in need of treatment because of pain. This patient was allocated to splint therapy. In total 95% of the patients were treated effectively.

## Discussion

This study investigated the use of exercise therapy for the treatment of patients suffering from MPD syndrome of the temporomandibular joint. Treatment consisted of active and passive jaw movement exercises, correction of body posture and relaxation techniques. Active jaw movement exercises were used to strengthen the muscles of mastication and to correct the jaw closure pattern (Horne & Rugh, 1980). Passive movement exercises are said to relive myofascial pain and restore normal movement of restricted joints (Lewit & Simons, 1984), especially if patients practice these exercises regularly by their own on a home programme (Lewit & Simons, 1984). As recommended in a recent paper (De Wijer *et al.*, 1996), treatment focused also on a correction of body posture, as several studies revealed a close interrelationship between the cervical spine and the




[a]MANOVA F = 8·1; Wilcoxon test: Z = –2·4; P < 0·02 [b]MANOVA F = 119·7; Wilcoxon test: Z = –3·9; P < 0·001: [c]MANOVA F = 10·6; Wilcoxon test: Z = –2·2; P < 0·03 [d]MANOVA F = 126·0; Wilcoxon test: Z = –3·9; P < 0·001 [e]MANOVA F = 31·2; Wilcoxon test: Z = –3·8; P < 0·001

**Fig. 3.** Influence of treatment on median (25 and 75% quartile) VAS ratings of pain at rest, pain at stress and impairment, as well as on incisal edge clearance. A MANOVA was used to identify significant changes between base-line and before treatment investigation, between before treatment and after treatment investigation and between after treatment investigation and 6-month follow up.

craniomandibular complex. Cervical posture influences the rest position of the mandible (Makofsky *et al.*, 1991), mandibular movement (Goldstein *et al.*, 1984), and the electromyographic activity of the masseter and temporalis muscle (Boyd *et al.*, 1987). Beside influences of the cervical spine, other postural faults like leg length difference (Robinson, 1966) or a flat foot may affect the temporomandibular joint too (Valentino *et al.*, 1991).

Pain has shown to be the most impairing symptom in CMD. About 50% of functional impairment are based on the impact of pain (Kropmans *et al.*, 1999). Additionally most people with clinically detectable dysfunction, like decreased mouth opening, are not impaired by this dysfunction and are not in need of treatment (Schiffman *et al.*, 1990). Therefore we used the VAS pain rating as the primary target parameter. It is an easy to use tool, and is reliable (Scott & Huskisson, 1976). Although there exist dysfunction indices, we did not use them, because they have distinct disadvantages. The Helkimo index (Helkimo, 1974) uses a non-linear rating system, and was developed for epidemiological research, and the craniomandibular index (Fricton & Schiffman, 1987) strongly involves muscle palpation, making it difficult to obtain reliable results.

In this study all patients experienced pain on stress before treatment. After treatment and at the 6-month follow-up a significant pain reduction occurred, 80% of the patients experienced no pain at all, another 5% had occasional pain. These results are superior to those of recent studies using occlusal appliances to treat patients with myogeneous temporomandibular pain (Johansson *et al.*, 1991; Dao *et al.*, 1994), physical therapy modalities (Gray *et al.*, 1994; Talaat *et al.*, 1986), behavioural therapy (Komiyama *et al.*, 1999), or a multimodal treatment approach consisting of a stabilization appliance, exercise therapy, muscle injections and various forms of physical therapies (Clark *et al.*, 1988 ID).

Restriction of mouth opening, which had been present in 60% of the patients, was markedly improved with only three patients (15%) having less than 35 mm of incisal edge clearance 6 months after treatment. This result too is superior to splint therapy (Ekberg *et al.*, 1998).

## Conclusion

Exercise therapy seems to be useful in the treatment of MPD syndrome. The impairing symptoms, jaw pain and restricted movement, can be alleviated significantly.

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