Exercise Therapy for Craniomandibular Disorders

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ABSTRACT. Nicolakis P, Erdogmus B, Kopf A, Djaber-Ansari A, Piehslinger E, Fialka-Moser V. Exercise therapy for craniomandibular disorders. Arch Phys Med Rehabil 2000;81: 1137-42.

Objective: To evaluate the use of exercise therapy for the treatment of craniomandibular disorders (CMDs).

Design: Before-after trial. All patients were assigned to a waiting list, serving as a no-treatment control period.

Setting: Outpatient clinic for physical medicine and rehabilitation of the University of Vienna.

Patients: Thirty consecutive patients suffering from CMD with anterior disc displacement with reduction who were consulting a CMD service. Inclusion criteria: (1) symptoms lasting at least 3 months, (2) pain in the temporomandibular region, (3) a positive axiography, and (4) evidence of postural dysfunction. Twenty-six patients completed the study; no adverse effects occurred.

Interventions: Active and passive jaw movement exercises, correction of body posture, and relaxation techniques.

Main Outcome Measures: (1) Pain at rest, (2) pain at stress, (3) impairment, and (4) mouth opening at baseline, before and after treatment, and at 6-month follow-up.

Results: During the control period, no changes occurred. After the treatment, pain and impairment were significantly reduced (Wilcoxon test, $p < .001$). Four patients had a restricted mouth opening, in contrast to 15 before treatment (χ^2 test, $p < .005$). Joint clicking vanished in 13.3% and was reduced in another 13.3% (χ^2 test, $p < .01$). These results did not change until follow-up. Seventy-five percent of the patients were treated successfully.

Conclusion: Exercise therapy seems to be useful in the treatment of anterior disc displacement with reduction.

Key Words: Clinical trials; Pain; Temporomandibular joint disorder; Physical therapy; Rehabilitation.

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CRANIOMANDIBULAR disorders (CMDs) are common. The prevalence in the population ranges from 20% to 85%,[1-4] with an incidence of CMD symptoms of 6% at the age of 28 years.[1] Clinically significant temporomandibular disorder (TMD)-related jaw pain occurs in about 5% to 6% of the population.[2,5] A recent study found temporomandibular joint (TMJ) sounds in 50%, impaired mouth opening in up to 23%, and pain in up to 19% of the population.[6]

Despite similar signs and symptoms, such as pain in the TMJ and masticatory muscles, restricted mouth opening and joint noises, different pathologies may exist in CMDs, including myofascial pain dysfunction syndrome, internal derangement with and without reduction of the disc, and arthrosis.[7] A clinical progression has been described beginning with joint clicking, corresponding with internal derangement with reduction of the disc; progressing to locking, corresponding with internal derangement without reduction of the disc; and then to an end stage of osteoarthrosis.[8]

Treatment of CMD should be directed primarily toward the cause of disease.[9] Occlusal interference[10] was claimed to be a major factor for the development of CMD, but recent studies could not support this thesis.[2,11,12] Other factors include hyperactivity of the temporal and masseter muscle,[13] bruxism,[14] and stress.[15] Postural abnormalities have been postulated to have an influence on the development and perpetuation of CMD too.[16,17] Epidemiologic studies have shown that patients suffering from neck disorders reveal a higher percentage of CMD symptoms,[18] and the incidence of neck disorders in CMD patients is increased.[19] Moreover, a recent study found that patients with a negative treatment outcome reported more sensitive areas in the head, neck, and shoulders.[20] According to De Wijer and colleagues,[21] a TMD with a myogenous involvement should no longer be viewed as a local disorder of the stomatognathic system. The upper quarter—including the stomatognathic system, cervical spine, and shoulder girdle—should be evaluated in patients with more complex or persistent symptoms in the head and neck region.

To treat the cause of disease of CMD, exercise therapy seems to be a good choice. It has been used for a long time to treat musculoskeletal disorders, and has been claimed to be effective in treatment of CMD. Although the reports have been positive,[22-29] methodologic flaws make it difficult to judge its effectiveness. The main problems in the existing studies were (1) exercise therapy was administered together with other treatments,[22-27] (2) no control groups existed,[22,24-28] (3) failure to define which subgroup of CMD was treated,[22,24,25,27,29] and (4) the study population was too small.[28] Because the benefit of exercise therapy in the treatment of CMD has not yet been proven, this study was aimed at evaluating a treatment protocol including active and passive jaw movement, correction of body posture, and relaxation techniques.

MATERIALS AND METHODS

Thirty patients diagnosed as suffering from anterior disc displacement with reduction participated in this study. Patients were selected consecutively from subjects consulting the CMD service at the Department of Dentistry, University of Vienna, if they were willing to participate in the study, and if they met all of the following criteria: (1) diagnostic criteria in accordance with the diagnosis TMJ internal derangement with reduction,[30] (2) symptoms lasting at least for 3 months, (3) pain in the temporomandibular region, (4) joint clicking together with a straight or convex pathway finding on computerized axiography,[31] and (5) evidence of postural dysfunction. Patients were referred to the outpatient clinic for physical medicine and rehabilitation of the University of Vienna, where all subjects were examined by the same physiatrist in a standardized

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manner. After this examination, all patients were assigned to a waiting list for exercise therapy, serving as a no-treatment control period. Time on the waiting list was determined by availability of treatment.

Outcome Measures

(1) Pain at rest was measured with a visual analog scale (VAS). The VAS consisted of a 100-mm-long continuum, the extremes of which were labeled ''no pain'' and ''worst possible pain.'' The patient marked a certain length of this line that was equivalent to the intensity of pain experienced. The distance of this mark from the ''no pain'' end of the scale was measured.

(2) Maximal experienced pain during the last 2 days was measured with a VAS.

(3) Patients were instructed to rate their overall experienced impairment in daily life activities with a VAS, the extremes of which were labeled ''no impairment'' and ''worst possible impairment.''

(4) 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 millimeters.

(5) Change of self-perceived joint clicking in contrast to the condition at baseline examination was measured on a 4-point scale (vanished, better, equal, worse).

(6) Perceived improvement of jaw pain in contrast to the condition at base line examination was measured on a 7-point scale (excellent, distinct improvement, moderate improvement, equal, moderate, distinct deterioration, severe deterioration).

(7) Perceived improvement of jaw function in contrast to the condition at base line examination was measured on a 7-point scale (excellent, distinct improvement, moderate improvement, equal, moderate, distinct deterioration, severe deterioration).

The first 4 measures were recorded at baseline, immediately before, immediately after, and 6months after exercise therapy; the rest of the measures (5–7) were recorded only at the second, third, and final examination.

Exercise Therapy

The number of treatments was adapted individually to 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 minutes.

Exercise therapy was intended to improve coordination of the muscles of mastication, reduce muscle spasm, and alter the jaw closure pattern. It included massage of painful muscles, muscle stretching, gentle isometric tension exercises against resistance, guided opening and closing movements, manual joint distraction, disc/condyle mobilization, and correction of body posture. The therapy also included relaxation techniques, which consisted of deep breathing and contrasting muscle tension and muscle relaxation exercises.

Each patient learned a physical training program 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 self-administration.

Statistical Methods

According to a before-after trial, the time on the waiting list served as control period. Because time on the waiting list and treatment time were not equal, 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. Differences between this normalized data were analyzed with the *t* test for paired samples. Descriptive data were analyzed 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 7-point scale was reduced to a 3-point scale, improvement (excellent, distinct improvement), no change (moderate or no improvement; moderate deterioration), and worse (distinct or severe deterioration).

RESULTS

A total of 28 women and 2 men participated in this study (mean age, 33.1 ± 11.0yr). Patients experienced symptoms of CMD for a mean of 2.6 (range, 0.3–10) years. Mean duration on the waiting list was 27 (range, 10–85) days, and mean duration of treatment period was 39 (range, 20–65) days. Patients received a mean of 9.9 (range, 5–15) treatments. All patients completed the treatment. No adverse effects occurred. Two patients were not available for the 6-month control, and 2 patients were allocated to splint therapy after completing therapy because they were not satisfied with the treatment result, although both experienced a marked improvement of pain and jaw function. Thus, 26 patients were enrolled to the statistical analysis at the 6-month control.

Baseline Evaluation

Eleven patients experienced no pain during rest, but all patients reported pain on stress. Mean pain at rest was 28.4mm, maximal pain was 60mm, impairment was 67.1mm, and mean incisal edge clearance was 40mm (table 1). Sixteen patients had an impaired mouth opening (incisal edge clearance <40mm).

Pain

Mean pain intensity was reduced significantly as a result of treatment (tables 1, 2). At the end of therapy, 87% of the patients rated jaw pain excellently or distinctly improved, and 13% experienced a moderate pain reduction (fig 1). Eight patients had no pain at all (fig 2), and 10 patients had no pain at rest (fig 3).

Six months after treatment, 80% of the patients found their jaw pain had improved (fig 1), and no patient felt a deterioration in contrast to pretreatment condition. Seventy-three percent had no pain at rest (fig 3), and 50% felt no pain at all (fig 2). This further improvement, versus that from immediately after treatment, was significant. Mean pain at rest and stress increased slightly, but was still significantly lower than before treatment (table 1).

Table 1: Mean (25% Percentile; 75% Percentile) Intensity of Pain and Impairment and Incisal Edge Clearance

	Baseline (n = 30)	Pretreatment Investigation (n = 30)	Posttreatment Investigation (n = 30)	6-Month Control (n = 26)
Pain at rest	28.4(0;50)	29.6(0;53)*	7.6(0;11)†	8.4(0;4)**
Pain at stress	60.0(43;77)	61.9(49;80)*	20.3(0;32)‡	22.8(0;39)††
Impairment	67.1(56;82)	64.7(52;81)*	24.5(3;36)‖	22.7(0;48)‡‡
Incisal edge clearance	40.0(35;45)	41.5(35;49)*	45.7(40;50)¶	45.2(41;50)‖‖

The Wilcoxon test was used to identify differences between baseline and pretreatment investigation, between pretreatment and posttreatment investigation, and between pretreatment investigation and 6-month control.

* $p > 0.1$; † $Z = -3.7$, $p < .001$; ‡ $Z = -4.7$, $p < .001$; ‖ $Z = -4.70$, $p < .001$; ¶ $Z = -3.6$, $p < .001$; ** $Z = -3.0$, $p < .005$; †† $Z = -4.1$, $p < .001$; ‡‡ $Z = -4.3$, $p < .001$; ‖‖ $Z = -2.9$, $p < .005$.

Table 2: Effects of Treatment on Pain, Impairment, and Incisal Edge Clearance

	Control Period	Treatment Period	Paired Samples *t*-Test
Pain at rest	0.02 ± 0.33	−0.60 ± 0.65	$t = 4.7$; $p < .001$
Pain at stress	0.15 ± 0.75	−1.18 ± 0.64	$t = 6.5$; $p < .001$
Impairment	−0.06 ± 0.58	−1.10 ± 0.65	$t = 5.7$; $p < .001$
Incisal edge clearance	0.06 ± 0.25	0.12 ± 0.15	$t = -0.9$; $p > 0.1$

Values represent daily changes (mean ± standard deviation).

Impairment

After therapy, patients felt a significant improvement of jaw function lasting until follow-up (tables 1, 2, fig 4). Incisal edge clearance improved (tables 1, 2) and only 4 patients had a restricted mouth opening, in contrast to 15 before treatment (fig 5). This result did not change in the next 6 months.

Joint Clicking

Joint clicking vanished in 13.3% and was reduced in another 13.3% patients after treatment. Six months later, 11.5% of the patients experienced no joint clicking, in 15.4% joint clicking was reduced, and in 1 patient a deterioration had occurred (fig 6).

At the 6-month follow-up, 5 of the remaining 26 patients were in need of treatment, 4 owing to pain, and 1 excessive joint clicking. Two patients were treated with physiotherapy, another 2 with splint therapy, and 1 patient with acupuncture. In total, 21 of 28 patients were treated effectively; thus, the success rate was 75% in this study.

DISCUSSION

This study investigated the use of exercise therapy for the treatment of patients suffering from anterior disk displacement with reduction. Treatment consisted of active and passive jaw movement exercises. They have shown to influence the jaw closure pattern,[32] relieve myofascial pain, and restore normal movement of restricted joints,[33] especially if patients practice these exercises regularly on their own with a home program.[33] As was recommended, treatment also focused on correcting body posture.[21] A close interrelationship between the cervical spine and the craniomandibular complex exists: cervical posture influences the electromyographic activity of the masseter and temporalis muscle,[34] mandibular movement,[35] and the rest position of the mandible.[36] Anterior head posture affects the forces on the mandible by increasing the tension in masticatory muscles that pull the mandible upward. This muscle tension could be further heightened by the increased effect of gravity,[37] the cervical hyperlordosis accompanying the anterior head posture,[38] or by compression of the cervical apophyseal joints.[39] As the cranium rotates backward by craniovertical and craniocervical angulation, the occiput is translated anteriorly, causing a simultaneous forward shift of the whole maxillary dentition in relation to the mandible. To obtain occlusal support, the

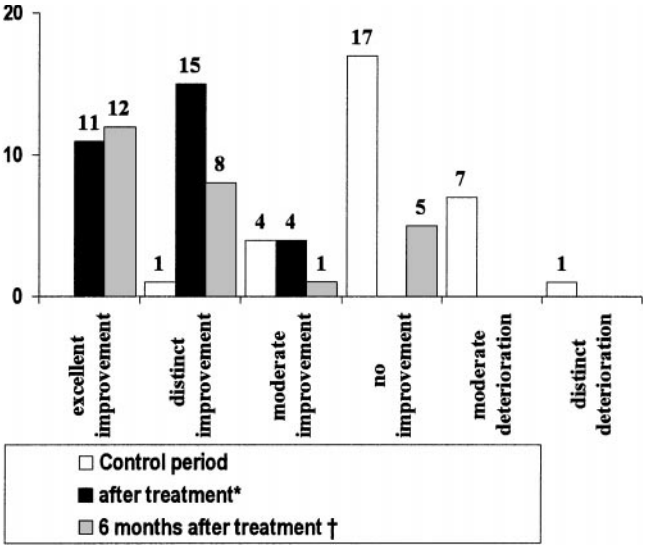

Fig 1. Influence of treatment on perceived improvement of jaw pain. * Difference between control period and treatment period, χ^2 test; 42.1; $p < .001$; † Difference between treatment period and follow-up, χ^2 test, 0.9; $p > 0.1$.

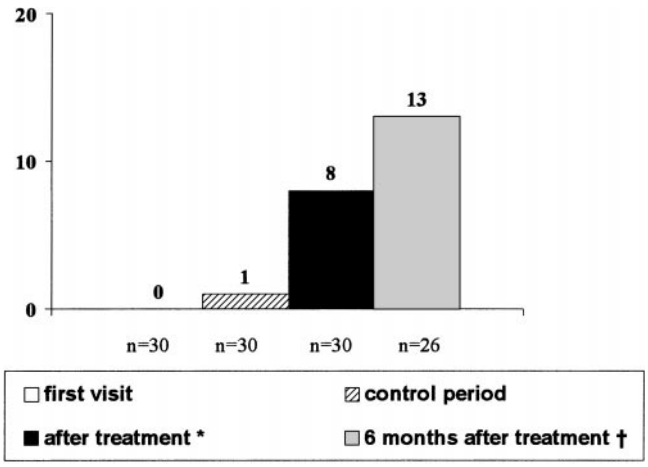

Fig 2. Influence of treatment on the number of patients experiencing no pain at all. *Difference between control period and treatment period χ^2 test: 6.4, $p < .05$; †Difference between treatment period and follow-up χ^2 test: 3.2, $p > .05$.

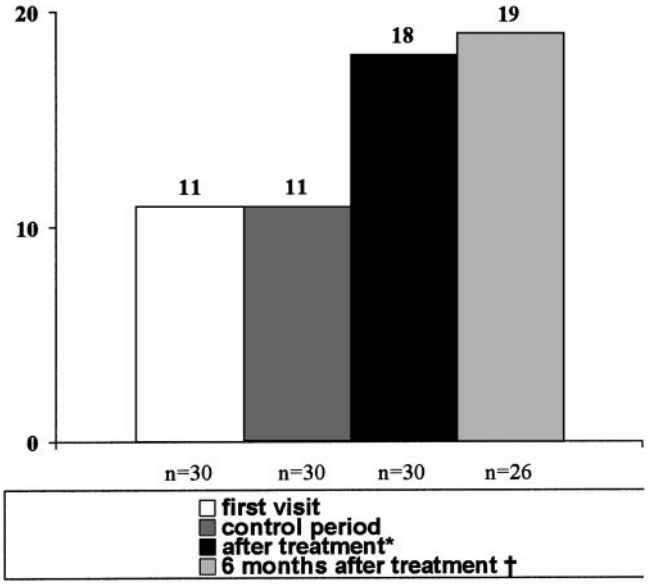

Fig 3. Influence of treatment on the number of patients experiencing no pain at rest. * Difference between control period and treatment period, χ^2 test, 3.3; $p > .05$; † Difference between treatment period and follow-up, χ^2 test, 1.1; $p > 0.1$.

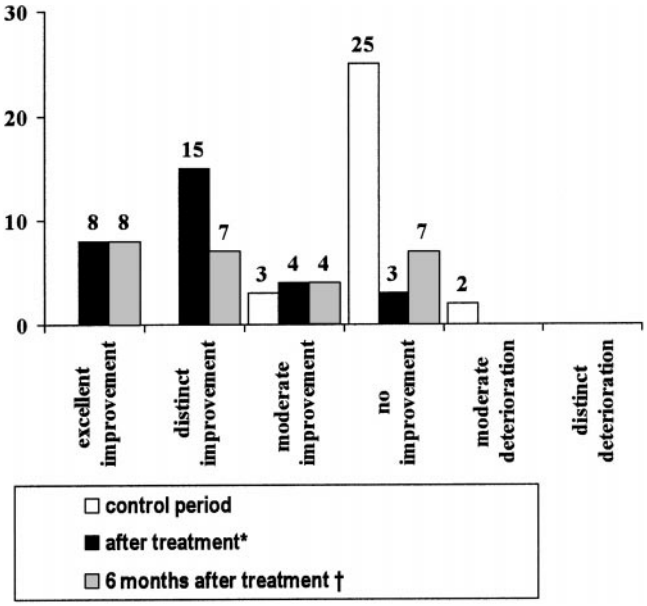

Fig 4. Influence of treatment on perceived improvement of jaw function. * Difference between control period and treatment period, χ^2 test, 37.3; $p < .001$; † Difference between treatment period and follow-up, χ^2 test, 2.3; $p > 0.1$.

mandible must be forced anteriorly, a situation that would likely affect the muscular balance in this supporting mechanism, particularly in the lateral pterygoid muscle.[40] This increased muscular activity may lead to an anterior disc displacement. Because the spine functions as a biomechanical unit, a dysfunction in any part may lead to dysfunction of the unit as a whole, and by this influence, the function of the temporomandibular complex.[41,42]

Pain was the most impairing symptom in this patient sample. Although most of the patients experienced joint clicking for several years, and several patients had an impaired mouth opening, they needed no treatment. Only the occurrence of severe pain forced them to search for help. This coincides with findings that most people with clinically detectable dysfunction are not impaired by this dysfunction and are not in need of treatment.[43] These findings favored the use of VAS pain ratings as the primary target parameter and not a dysfunction index.[44,45] The VAS has shown its reliability,[46] and is an easy-to-use tool, whereas the craniomandibular index[45] strongly involves muscle

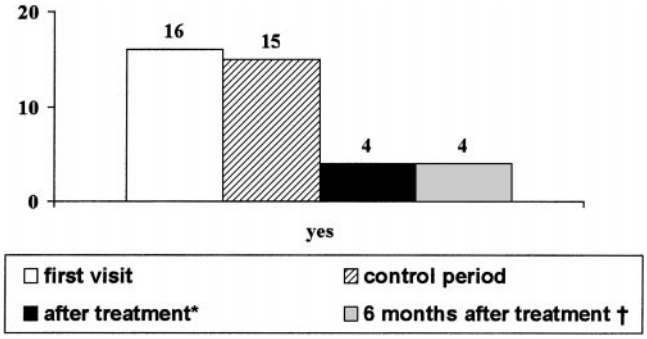

Fig 5. Influence of treatment on the number of patients with an incisal edge clearance <40mm. * Difference between control period and treatment period χ^2 test, 9.3; $p < .005$; † Difference between treatment period and follow-up, χ^2 test, 0.1; $p > 0.5$.

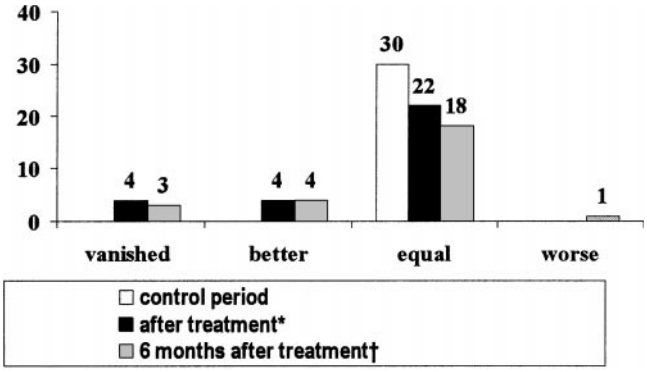

Fig 6. Influence of treatment on the perceived improvement of jaw clicking. * Difference between control period and treatment period, χ^2 test, 9.2; $p > 0.0$; † Difference between treatment period and follow-up, χ^2 test, 1.2; $p > 0.5$.

palpation, making it difficult to obtain reliable results. The Helkimo index[44] uses a nonlinear rating system, which has distinct disadvantages for statistical evaluation, and was developed for epidemiologic research.

In this study, each patient experienced pain before treatment. After treatment and at the 6-month follow-up, a significant pain reduction occurred: 50% of the patients experienced no pain at all, and another 23% had occasional pain. These results are superior to those of recent studies using occlusal appliances to treat patients with arthrogeneous[47] or myogeneous temporomandibular pain,[48,49] and at least equal to previous studies using either physical therapy modalities,[50,51] or a multimodal treatment approach consisting of a stabilization appliance, exercise therapy, muscle injections, and various forms of physical therapy.[25]

Restriction of mouth opening, which had been present in 16 patients, was markedly improved with only 4 patients having less than 40mm of incisal edge clearance 6 months after treatment. This result is also superior to splint therapy.[47]

All patients rated their impairment of daily life at least with 23mm on a 100-mm VAS before treatment. Therapy significantly improved impairment of daily life. This effect lasted until follow-up. Again, our results are superior to splint therapy.[48]

Joint clicking is the diagnostic criterion for this disease. Recent studies found up to 50% of the population exhibiting this symptom.[6,43] Different interocclusal appliances have been suggested for anterior displaced disc with reduction in conservative treatment, but symptoms return quickly after removal of repositioning splints.[52] A permanent change of the occlusion can capture the disk in a correct position relative to the condyle in about 80%, but extensive dental treatment[53] would be necessary. In addition to splint therapy, therapeutic jaw exercises were recommended. Previous research reports gave reason to believe that joint clicking could be influenced by changing the jaw closure patterns.[26,32] Unfortunately, exercise therapy did not reduce this symptom as pain and joint function. It stopped in 12.5% and decreased in another 12.5%. This coincides fairly well with results of a previous report, in which joint clicking was affected unpredictably, with a reduction of the sound immediately after exercise in about 50%, and longer lasting effect in 25%.[54] Kirk and Calabrese[26] reported more favorable results, giving a overall success rate of 38.6% in eliminating joint clicking 3 years after treatment. Unfortunately, results are given according to a classification of five categories of disc displacement, relating to the occurrence of joint clicking while opening the mouth. The duration of

symptoms was disregarded. It is possible that the success of the treatment depended on the duration of symptoms and not on the grade of disc displacement, because groups being treated successfully consisted mainly of patients with symptoms for less than 1 year. This could explain the more favorable results, because in our study, patients had more long-lasting symptoms. Additionally, patients received other physical treatments as well, including ultrasound, which also might have improved joint clicking.[51] Therefore, the impact of exercise therapy on the results cannot be estimated.

Although joint clicking may be disturbing, it is said to be a generally benign condition.[55] In symptomatic subjects, concurrent internal derangement also can occur in the asymptomatic side,[56] so it cannot be the sole source of pain. Additionally, the prevalence of joint clicking is up to 50% of the population, but only a few of these persons need treatment.[6,43] Moreover, a recent follow-up study found that internal derangement does not result in increased impairment in contrast to a control group 30 years after treatment.[57] It is therefore speculated that it might be part of normal joint adaptation with age.[56] As a consequence, the need for treatment of joint clicking without pain is questionable.

CONCLUSION

Exercise therapy seems to be useful in the treatment of anterior disc displacement with reduction and pain. The impairing symptoms, jaw pain, and restricted movement can be alleviated significantly.

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