Short-term efficacy of physical therapy compared to splint therapy in treatment of arthrogenous TMD

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SUMMARY A prospective randomized study was carried out to evaluate the efficacy of physical therapy in addition to splint therapy on treatment outcome in patients with temporomandibular disorders (TMD) with respect to objective and subjective parameters. Twenty-six patients suffering from an arthrogenic TMD and exhibiting a painfully restricted jaw opening were randomized in two groups. Thirteen patients were treated solely with Michigan splint (group I), 13 patients received supplementary physical therapy (group II). Before treatment a clinical examination and electronic recording of jaw movements were performed and subjective pain level was evaluated by visual analogue scales. After 3 months of therapy maintenance of improvement was evaluated. Within treatment groups comparison of data before and after treatment was analysed using Wilcoxon test. Groups were compared by Mann–Withney-U test. A P-value < 0.05 was considered significant. Compared with the baseline, in both groups mandibular movement capacity increased significantly after treatment, whereas subjective pain decreased significantly (P < 0.05). Active jaw opening increased from 28.6 ± 5.8 to 35.9 ± 4.8 mm in group I and from 30.1 ± 5.4 to 40.8 ± 4.1 mm in group II. After therapy the difference of active jaw opening between groups was significant (P < 0.05). Physical therapy also gave a supplementary improvement of protrusive mandibular movement capacity during electronic registration and subjective pain level. For none of these parameters this difference between groups was significant. Physical therapy seems to have a positive effect on treatment outcome of patients with TMD.

KEYWORDS: physical therapy, efficacy, splint, treatment, arthrogenous, temporomandibular disorders

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Introduction

Arthrogenic temporomandibular disorders (TMD) are associated with pathologic changes of the condylus-disc relation, bone remodelling and degenerative changes of the condyle. These pathologic changes can induce signs and symptoms of a TMD. Patients suffering from TMD frequently exhibit pain on palpation in the region of the temporomandibular joint (TMJ) and the masticatory muscles, joint sounds like clicking or crepitus and restricted jaw movements. The aetiology of TMD is considered to be multifactorial (1). Various factors like excessive loading on the TMJ as a result of loosing posterior teeth support, parafunctional activity and rheumatic diseases are discussed to cause TMD (2–5). As a consequence of the multifactorial pathogenesis, therapeutic concepts must be interdisciplinary. This interdisciplinary conservative treatment includes combinations of splint-, pharmacological- and physical therapy as well as psychological approaches. Splint therapy is performed applying various types of stabilization, repositioning or relaxation splints. For medical therapy, usually non-steroidal anti-rheumatic drugs and muscular relaxants are used. In recent studies improvement of jaw-opening and subjective pain levels by splint therapy and medical treatment was shown.

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In physical therapy joint mobilization by traction, detoning exercises and massages of masticatory muscles are usually used to reduce signs and symptoms of TMD (9). Prospective studies investigating the effects of physical therapy on treatment outcome within an interdisciplinary concept are rare.

Therefore, the purpose of the present study was to investigate the efficacy of physical treatment in addition to splint therapy in patients suffering from arthrogenous TMD with a painful restricted jaw movement.

**Materials and Methods**

**Selection of patients**

The study was approved by the Ethics Committee of Hannover Medical School (no. 3747). The study was undertaken with the understanding and written consent of each subject.

Twenty-six patients who suffered from acute symptoms (duration <6 months) of a TMD and who were treated in the Department of Prosthetic Dentistry of the Hannover Medical School between 2002 and 2006 for that reason were included in the present study. Inclusion criterion was the diagnosis of an arthrogenic TMD with a limited (<38 mm) and painful jaw opening. For confirmation of the clinical diagnosis magnetic-resonance imaging (MRI) examinations were carried out with closed and open jaw position using proton density biplanar coronal and sagittal scans and fat saturated T2 sagittal enhancement (General Electric, 1.5 T, Excite platform, Waukesha, WI, USA).

Exclusion criteria were the presence of systemic diseases, especially rheumatic diseases, other types of treatment of TMD (e.g. prior operative or medical therapy), therapeutic co-interventions during treatment, signs of psychosomatic illness and insufficient compliance of patients.

**Therapeutic intervention and evaluation of treatment outcome**

Before treatment all patients were clinically examined according to the RDC/TMD criteria (10).

The patients were divided into two treatment groups using permuted block randomization with block sizes of four. In both groups no drop-outs were recorded. The patients in group I (n = 13) underwent Michigan splint therapy. The patients in group II (n = 13) were given physical treatment in addition to the splint. For each patient, an upper jaw splint was prepared as described by Ash and Ramfjord (11). The patients were instructed to wear the splints 24 h a day, excluding mealtimes.

The physical treatment was based on the guidelines for manual therapy to mobilize the TMJ (12). To mobilize the joint, passive traction and translation movements were carried out in every restricted direction, which were most craniocaudal, cranoventral or mediolateral. This mobilizing procedure was accompanied by detoning exercise of jaw elevator muscles. When the muscle tone in the jaw elevator was high, the patient was prepared for the manual therapy with a detoning massage. All patients were treated for 45 min twice a week (total: 90 min) by the same physical therapist.

All patients were examined and controlled 1, 4, 8 and 12 weeks after the start of treatment by one examiner. Active and passive maximum jaw opening were taken as objective criteria to evaluate the mobility of the lower jaw. In each session measurements were performed three times and data was averaged. In addition, a subjective pain evaluation was made by the patient using a visual analogue scale, with ratings between 0 for pain-free and 100 for maximum pain (13). Pain was differentiated in total pain intensity, pain intensity during mandibular movement, pain intensity without mandibular movement and pain intensity after mandibular loading.

An electronic registration was performed before therapeutic intervention and in the last session after 12 weeks using an infrared-based system (String Condylom LR3; Dentron, Hoechberg, Germany). First the head frame was mounted. Afterwards the transmitter frame was attached to the mandibular teeth with an individualized paraocclusal appliance (PalatrayXL; Heraeus Kulzer, Hanau, Germany) using hard silicone (Futar D Occlusion; Kettenbach, Eschenburg, Germany). The sensor boxes were placed in the region of the left and right TMJ with respect to the marked arbitrary hinge axis located 12 mm anterior the tragus and 3 mm under the line tragus-canthus according to the procedure manual. Recording individual hinge axis the registration system was adjusted using special String software (Jaws 2.0; Dentron). Maximum protrusive mandibular movements under tooth guidance were recorded three times after initial instruction. Left and right measurements were averaged, and processed with the software, allowing the calculation of mandibular mobility.
Statistical analysis

Power and sample sizes were calculated using nQuery Advisor 5.0 (Statistical Solutions, Saugus, MA, USA). Before the start of the study maximum active jaw opening was defined as the main criterion. Power calculation revealed that a sample size of 13 in each group will have 85% power to detect a difference in means of 5.0 mm assuming that the common standard deviation is 4.0 mm.

Documentation and evaluation of the data was performed with data processing program SPSS/PC Version 13.0 for Windows (SPSS Inc., Chicago, IL, USA). All data was analysed by one blinded researcher. First the means and standard deviations of
  – maximum active jaw opening,
  – maximum passive jaw opening,
  – maximum protrusive mandibular movement during electronic registration,
  – total pain intensity,
  – pain intensity during mandibular movement,
  – pain intensity without mandibular movement and
  – pain intensity after mandibular loading were determined. Mann-Whitney-U test was used to compare baseline characteristics and treatment outcome of the two groups. In addition categorical variables of the baseline were compared by use of Fisher’s exact test. Treatment outcome in both groups compared with the baseline was analyzed using Wilcoxon test. A P-value <0.05 was considered statistically significant for all performed tests.

Results

In group I, three males and 10 females were included with an average age of 44.5 ± 14.1 years. In 11 patients, a disc displacement without reduction, in one patient a disc displacement with reduction and in one patient an osteoarthrosis was diagnosed. In group I, 10 patients exhibited myofascial pain before therapeutic intervention. All patients in group II were females aged 41.7 ± 16.5 years. In 10 of them a disc displacement without reduction, in two patients a disc displacement with reduction and in one patient an osteoarthrosis was found. In group II eight patients showed myofascial pain before treatment. Comparison of baseline characteristics revealed no significant differences between groups (Table 1).

Figures 1–4 summarize the improvement of the recorded parameters. Analysis of treatment outcome showed that in both groups all analysed parameters improved significantly during treatment compared with the baseline.

In group I maximum active jaw opening was 28.6 ± 5.8 mm before therapeutic intervention with Michigan splint (Figure 1). After 12 weeks of treatment

<table>
<thead>
<tr>
<th>Table 1. Comparison of baseline characteristics</th>
<th>Group I</th>
<th>Group II</th>
<th>Significance</th>
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</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>44.5 ± 14.1</td>
<td>41 ± 16.5</td>
<td>n.s.</td>
</tr>
<tr>
<td>Sex</td>
<td>3 m</td>
<td>0 m</td>
<td>n.s.</td>
</tr>
<tr>
<td>Sex</td>
<td>10 f</td>
<td>13 f</td>
<td></td>
</tr>
<tr>
<td>Active mouth opening</td>
<td>28.6 ± 5.8 mm</td>
<td>30.1 ± 5.4 mm</td>
<td>n.s.</td>
</tr>
<tr>
<td>Protrusive movement capacity</td>
<td>5.9 ± 2.4 mm</td>
<td>5.8 ± 1.8 mm</td>
<td>n.s.</td>
</tr>
<tr>
<td>Total pain intensity</td>
<td>42 ± 22</td>
<td>45 ± 20</td>
<td>n.s.</td>
</tr>
<tr>
<td>Myofascial pain</td>
<td>10 patients</td>
<td>8 patients</td>
<td>n.s.</td>
</tr>
</tbody>
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active jaw opening increased to $35.9 \pm 4.8$ mm ($\Delta 7.3 \pm 6.2$ mm; $P < 0.05$). Group II exhibited an active jaw opening of $30.1 \pm 5.4$ mm before and $40.8 \pm 4.1$ mm after combined treatment with splint and physiotherapy ($\Delta 10.4 \pm 5.4$ mm; $P < 0.05$). Analogous results were obtained for the passive jaw opening (Figure 2), which in group I was $30.5 \pm 6.5$ mm before and $38.4 \pm 4.8$ mm after treatment ($\Delta 7.9 \pm 5.7$ mm; $P < 0.05$). In group II, this parameter changed from $31.9 \pm 5.3$ to $42.1 \pm 4.7$ mm ($\Delta 10.7 \pm 5.1$ mm; $P < 0.05$). Comparison of data between groups revealed that active jaw opening was significantly higher in group II after treatment ($P < 0.05$), whereas the difference between groups for the passive jaw opening was not statistically significant.

The analysis of data obtained from electronic registration (Figure 3) showed, that in group I maximum protrusive mandibular movement during electronic registration improved from $5.9 \pm 2.4$ to $7.4 \pm 2.7$ mm ($\Delta 1.5 \pm 1.5$ mm; $P < 0.05$), whereas in group II this parameter improved from $5.8 \pm 1.8$ to $8.3 \pm 2.7$ mm ($\Delta 2.5 \pm 2.6$ mm; $P < 0.05$). The difference between groups was not statistically significant.

Analysis of subjective pain evaluation in group I gave an improvement of total pain intensity ($\Delta 23 \pm 22$; $P < 0.05$) (Figure 4), pain intensity during mandibular movement ($\Delta 25 \pm 22$; $P < 0.05$), pain intensity without mandibular movement ($\Delta 8 \pm 9$; $P < 0.05$) and pain intensity after mandibular loading ($\Delta 36 \pm 25$;
in determination of subjective pain improvement (23). In the present study, 23 women and only three men fulfilled criteria of inclusion. This difference between the sexes can be explained by the higher prevalence of TMD in female persons (24, 25).

Patients in both groups revealed a significant improvement of objective and subjective parameters during treatment. In literature improvement of these parameters during splint therapy was found (6, 16, 26). An early begin of splint therapy was supposed to improve treatment outcome (27). As all patients revealed acute symptoms of TMD and therapeutic intervention was not prolonged, the improvement of mandibular mobility and pain level in both groups can be explained by the cited findings. The reduction of pain intensity might also be the consequence of a regression or spontaneous remission of acute symptoms.

Comparison of groups showed a significantly higher active jaw opening after physical therapy. The smallest detectable change in active mouth opening can be reduced from 9 to 6 mm by performing multiple measurements. Therefore, data of vertical mandibular movement capacity was obtained three times per session (28). With an average maximum active jaw opening of 35.9 mm in group I after treatment with Michigan splint only, jaw opening has to be considered as restricted. This aspect has to be regarded carefully, as one of the main goals in treatment of TMD is the restoration of a physiological mandibular movement, which was not achieved in group I.

A tendency of further improvement after physical therapy was recognizable for passive jaw opening, maximum protrusive mandibular movement capacity registered by electronic recording and for total pain intensity, but no significant differences between groups were found for these parameters. In literature, the efficacy of physical therapy in treatment of patients with TMD remains controversial. In a study of Stiesch-Scholz et al. comparison of medical and physical therapy in combination with splint therapy in patients with disc displacement without reduction showed no significant influence of physiotherapy on treatment outcome (8). These findings were explained by the application of various treatment methods from different not calibrated physiotherapists. Other researchers also found no additional benefit of physiotherapy during treatment of patients with anterior disc displacement without reduction (29).
In contrast another study showed that manual physical therapy, therapeutic exercises and patient education improved jaw opening and pain level in patients with anterior disc displacement without reduction (30). Further studies showed the efficacy of exercise therapy and physiotherapy in patients with myofascial pain, internal derangements and cervical spine dysfunction (31–35). In patients with anterior disc displacement with reduction the application of therapeutic exercises significantly reduced joint clicking (36). Even in long-term outcome of TMD an effective treatment of osteoarthrosis using exercise therapy was reported (37). Comparison of the cited studies is difficult, as different criteria of inclusion were used, researchers and physiotherapists were not calibrated and various methods of physical therapy were applied.

In the present study, an approach to determine the clinical outcome of physical therapy in a randomized clinical trial was performed. Although clinical examination was performed by one dentist and physical therapy was applied by only one physiotherapist, only for one parameter significant differences were found between groups. As a tendency of further improvement of all subjective and objective parameters was recognizable, the lack of significance in some parameters might be due to the relatively low number of included patients.

With respect to the results of the present study and regarding findings in literature, efficacy of physical therapy seems to be depending on various factors. These factors could be the used physiotherapeutic methods as well as the subgroup of TMD. Furthermore, duration of signs and symptoms and pain level could play a role. To evaluate the influence of these factors prospective multicenter studies with calibrated researchers have to be performed with high sample sizes to show differences between groups. In these future studies comparison of single matched treatments should be carried out to determine relative effects and mechanisms of treatment.

References


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