THE EFFECTIVENESS OF SPECIFIC PHYSIOTHERAPY IN THE TREATMENT OF TEMPOROMANDIBULAR DISORDERS

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The aim of this study was to evaluate the effect of individual specific physiotherapy in the treatment of temporomandibular disorders, its immediate effect and its effect after two months. The research sample was comprised of 23 subjects, 17 women and 6 men, with an average age of 36.5 years. They complained of pain, sound phenomena and restricted mandibular movements. The patients were first examined by a stomatologist who recommended physiotherapy. The effect of treatment was assessed according to the intensity of pain, the occurrence of reflex changes in soft tissues in the region of the masticatory muscles and digastricus muscle, the range of mouth opening and the intensity of sounds produced by mandibular movements. It was found that after treatment pain was significantly reduced ($p < 0.001$) at the temporomandibular joint (from 4.2 points to 0.7 point on the VAS). There were also fewer reflex changes in the muscles and fascias. The range of mouth opening increased significantly (from 37.3 mm to 41.3 mm, $p < 0.001$) and the intensity of sounds was reduced from 100% to 43% ($p < 0.001$). The finding shows that this state was maintained two months later: intensity of pain ($p < 0.001$), mouth opening ($p < 0.003$) and reduction of sound phenomena ($p < 0.001$). Pain was ameliorated, the intensity of sounds reduced, and the range of movement significantly improved after specific physiotherapy.

Keywords: Temporomandibular joint, temporomandibular disorder, individual physiotherapy.

INTRODUCTION

The temporomandibular joint (TMJ) is one of the most frequently used joints of the human body. It is used when speaking, chewing, yawning, swallowing and other activities during the day and even in sleep. The frequency of movement is assessed as approximately 1500–2000 times a day (Hoppenfeld, 1976; Magee, 2002). The coordination of the mandibula and the maxilla with both the dental arches, the masticatory muscles with the activity of the neck muscles with their receptors in the periodontium, periost, in the muscles and joint capsules form an integrated harmonious unit. Its function is controlled by the central nervous system (CNS) (Bourbon, 1995). The primary disorder can originate at any level of this complex and cause its dysfunction. In the greatest number of cases the cause is a disturbance of function in the form of increased muscular tonus and myofascial trigger points (TrPs). It is essential to start treatment at the stage of mere dysfunction, i. e. at the stage when the changes are still reversible, in order to prevent irreversible structural changes.

The term "temporomandibular disorder" (TMD) stands for a number of disorders related to the masticatory muscles or the TMJs and related structures (Zemen, 1999).

According to epidemiological statistics, 70% of the randomized population suffers from at least one symptom or sign of TMD, but only one fourth of this number is aware of it and only 5% seek medical treatment (Dimitroulis, 1998; Pedroni, De Oliveira, & Guaratini, 2003).

AIM

The purpose of the paper is not only to demonstrate the effect and duration of specific individual physiotherapy. It is also to show some factors causing TMD, the percentage of individual symptoms and signs related to pain, the presence of reflex changes in soft tissues, sound phenomena and disturbed mobility of the mandible in our patients at the beginning and at the end of the treatment.

METHODS

Participants

The 23 subjects who sought treatment at the Department of Oral and Mandibular Surgery of the Faculty Hospital in Olomouc were included in the research sample. They complained of pain, sound phenomena and restricted mandibular movements. They were accepted for treatment during the period from October to December 2005. The patients were first examined by a stomatologist who recommended physiotherapy.

The group consisted of 17 women and 6 men. Their average age was 36.5 years. The average age of the women was 39.2 years, and of the men, 30.4 years. Informed consent was obtained from each patient.

Examination protocol

The most important symptoms of TMD and anamnestic/medical historical data about the duration of the complaints and possible provocative factors were assessed with a questionnaire. In addition to pain, sounds, movement restriction and other symptoms, such as instability of the TMJ, disturbance of hearing (tinnitus, a one sided loss of hearing), dizziness, vertigo, dysphagia, toothache, or increased dental sensitivity without true stomatological signs were identified. Anamnestic/medical historical data focused mainly on the duration of persisting problems, their location, the presence of bruxism, stress and mental tension. Previous dental treatment was of special interest as was the history of trauma to the mandible, head and neck.

The patients drew a picture of their pain, its site and irradiation. They were asked what aggravated and what relieved it, a possible circadian rhythm of pain and its intensity according to a scale from 0 to 10 (Visual Analogue Scale – VAS). This was evaluated at the beginning and the end of the treatment.

To assess the range of the mouth opening, the patient placed three knuckles, preferably of the non dominant hand, between the upper and lower incisors (Travell & Simons, 1998). For more exact measurements a slide gauge was used to measure the range of mandibular movement. In particular the distance between the centres of the upper and lower incisors was measured in millimetres with the mouth wide open. These tests were carried out before and after the treatment.

Each patient described what was subjectively heard when moving his/her jaw. The examination determines whether an audible click is heard at the start of the process of the opening of the mouth, in the course thereof or at the end or on closing the mouth. The intensity of the sound was described according to a scale from 0–3 (0 = no sound, 1 = minimal click, 2 = causing discomfort, 3 = audible to others, causing severe discomfort). This, too, was assessed at the beginning and at the end of the treatment. To evaluate the results of the treatment, the intensity of the sound was considered at the beginning to be 100% and was compared to the intensity at the end in percentages.

The examination of the TMJ covers active movement, joint play, the direction in which the incisors move and palpation of the TMJ and the hyoid. The soft tissues involved are also examined (the masticatory muscles, the digastricus and mylohyoideus, the neck muscles and also the fascias and scalp). The cervical spine was examined as well.

Physiotherapeutic protocol

Individual physiotherapy was given in ten sessions which included soft tissue and mobilisation techniques and therapeutic exercise under the guidance of an experienced physiotherapist. Each session lasted 30 minutes and was practiced twice a week for five weeks. A control examination took place after two months in 10 patients in order to verify a more lasting effect. In the course of the treatment, the method was tailored to the individual findings and the needs of the patient. As a rule, physiotherapy for TMD patients proceeds in the following three stages:

During the first stage, the physiotherapist gives instructions to and explains to the patients the symptoms, the causes and consequences of his/her problems and the therapeutic options. This relieves the patient's uncertainty and apprehensions which might complicate the treatment. In this way, the patient's confidence, so essential for a successful treatment, is obtained. The main object of this first stage is to find the principal factors which perpetuate the condition and to teach the patient how to deal with them. The patient learns what the bad habits are which overstrain the TMJ and how to eliminate them. These factors include finely cut and soft food, chewing food symmetrically on both sides, and insufficient opening of the mouth in the pain free range, especially when yawning (Michelotti, de Wijer, Steenks, & Farella, 2005).

The objective of the second stage is to normalize the range of movement of the TMJ and the soft tissue tension in the entire region of the head and neck. Fascias were treated by myofascial release techniques according to Greenman (1996), myofascial trigger points and muscle spasm by post isometric relaxation (PIR) according to Lewit (2003) and "trigger point pressure release" according to Mense and Simons (2001). Soft tissue treatment was repeated until no pathological resistance against shifting or stretching, i. e. normalisation of pathological barriers, could be felt. Care was taken not to increase any pain in the course of soft tissue

treatment. The normal range of the mouth's opening was obtained by mobilisation according to Hengeveld and Banks (2005). The hyoid was mobilised by PIR according to Lewit (2003).

The objective of the third stage is to train coordination, in particular the stereotype of mandibular abduction and adduction. This is achieved by eliminating the deviation of the chin's position and reducing the mouth opening in case of hypermobility. Specifically, the patients learn how to control the position of the mandibula at rest, to activate the depressors of the mandible and its retrusion and to perform a controlled rotation of the condyles. A further objective is stabilisation by means of strengthening weak muscles, preferably using diagonal movements for both coordination and strength. All the exercises were initially repeated 3–5 times and the number of repetitions was gradually increased up to 10. The movement was carried out in such a way so as not to cause pain and sound phenomena. Further details about the practical aspects of the exercises were published by Velebová and Smékal (2007).

Statistics

The data from the measurements were processed using the "Statistica 6.0" programme. Basic statistical values (arithmetic averages, medians, standard deviations and quartile ranges) were obtained in this way. Based on angularity and acuteness, a corresponding test for the comparison of the data was selected. The Wilcox pair test, a non parametric test of two variables, was used for the evaluation of the data (the intensity of pain in the region of the TMJ, the range of movement and the intensity of sounds) for the entire group. Friedmann's ANOVA and Kendall's conformity coefficient, a non parametric test of several dependent variables, were used to assess the data two weeks after the treatment.

RESULTS

The most important anamnestic/medical historical factor in the development of TMD was dental treatment, 43.5%, followed by emotional stress, 39.1% and oral parafunctional occlusal contact, 34.8% (Fig. 1).

Predisposition to TMD was higher in students and pupils than in any other group of the population (Fig. 2). The most frequent initial symptoms were sound phenomena 95.7%, pain 82.6%, and stiffness or restricted mandibular movements 69.6% (Fig. 3). Further TMD symptoms were toothache without stomatological cause, 47.8%, auditory problems such as tinnitus and unilaterally reduced hearing, 47.8%, dysphagia, non inflammatory pain in the throat, a feeling of instability upon maximum opening of the mouth or during fast mandibular movement, 34.8%, and dizziness 17.4% (Fig. 3).

The most frequent reflex changes were found in the masseters, 91.3% before and 47.8% after the treatment. The second most frequently affected muscle was the pterygoideus lateralis muscle, 89.1%, which dropped to 56.5% after the treatment. In 67.4% of the cases, the pterygoideus medialis muscle was affected before the treatment and after the treatment by 10.9%. The temporalis muscle showed reflex changes only in 26.1% of the cases before and in 15.2% of the cases after treatment. The smallest number of changes was found in the digastricus muscle in 13% of the cases, both in its venter anterior and posterior positions. This dropped to 6.5% after the treatment (Fig. 4).

Reflex changes in galea aponeurotica were found in 65.2% of the cases and after the treatment in 17.4% of the cases. Changes were found in the pretracheal fascia of the neck on the right, 56.5%, and on the left, 34.8%, before and 26.1% on the right and 21.7% on the left after treatment. Restriction of functional movement on the right side of the hyoid was found in 56.5% of the cases before the therapy and in 21.7% of the cases after the therapy. Restriction of the functional movement of the left side of the hyoid was found in 34.8% of the cases and after the therapy the number decreased down to 4.4% (Fig. 5).

In the course of treatment patients experienced a statistically significant reduction of the intensity of pain, from the initial 4.2 points to 0.7 at the end, i.e. by 3.5 points ($p = 0.0013$ by the Wilcox matched pair test).

A statistically significant increase in the range of mandibular abduction was also achieved by individual physiotherapy from an initial average of 37.3 mm to a final 41.3 mm, i.e. an increase of 4 mm ($p = 0.0002$ by the Wilcox matched pair test).

During mandibular movement, a statistically significant reduction of sound phenomena by 57% was achieved. Their intensity decreased from an original 100% to 43%. This result was significant ($p = 0.0002$) according to the Wilcox pair test.

Symptoms improved or disappeared after the treatment in 96% of the cases (Fig. 6).

This effect was shown in 10 cases 2 months after the treatment. Pain at the TMJ decreased from an average of 5.8 points to 1.1 points after the treatment and to 0.4 points after two months. This difference was significant at a level of $p = 0.0009$ according to Friedmann's ANOVA.

The abduction range of the TMJ increased in this group from 37.6 to 41.1 mm at the end of the treatment and was 44.7 mm after two months. This difference was significant ($p = 0.0021$ according to ANOVA).

The intensity of sound phenomena decreased from an original of 100% to 29.5% at the end of the treatment and was 16% after two months. This difference was significant ($p = 0.0001$ according to ANOVA).

Fig. 1
Etiological factors of temporomandibular disorder

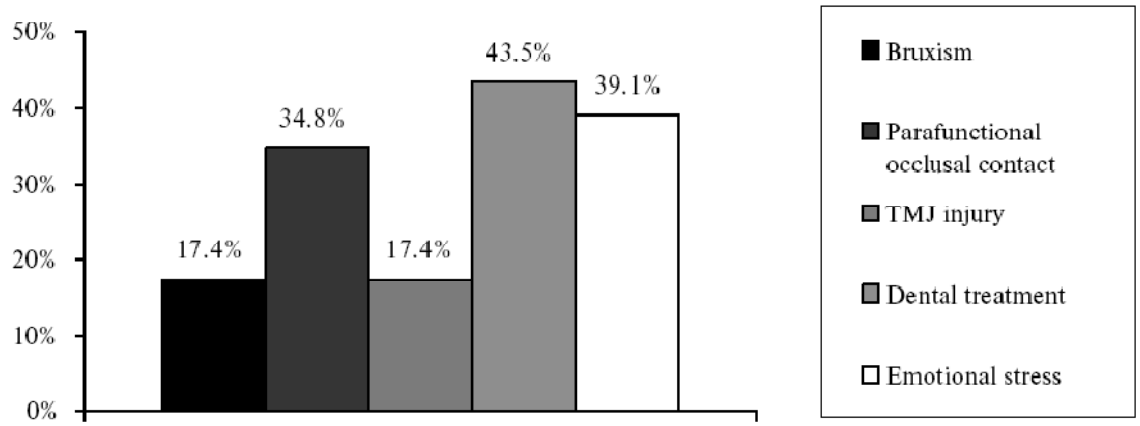


Fig. 2
Predisposition to temporomandibular disorder in different groups of the population

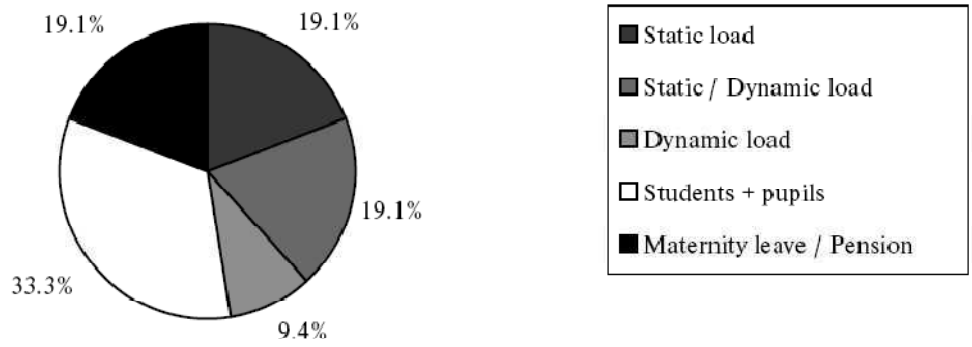


Fig. 3
Distribution of symptoms of temporomandibular disease before and after therapy

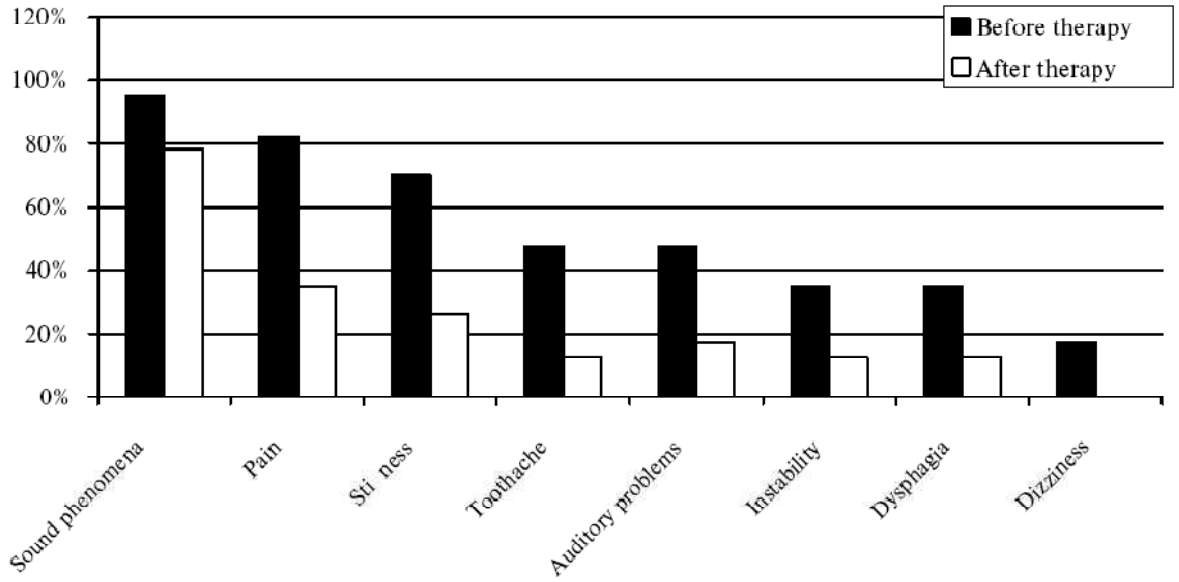
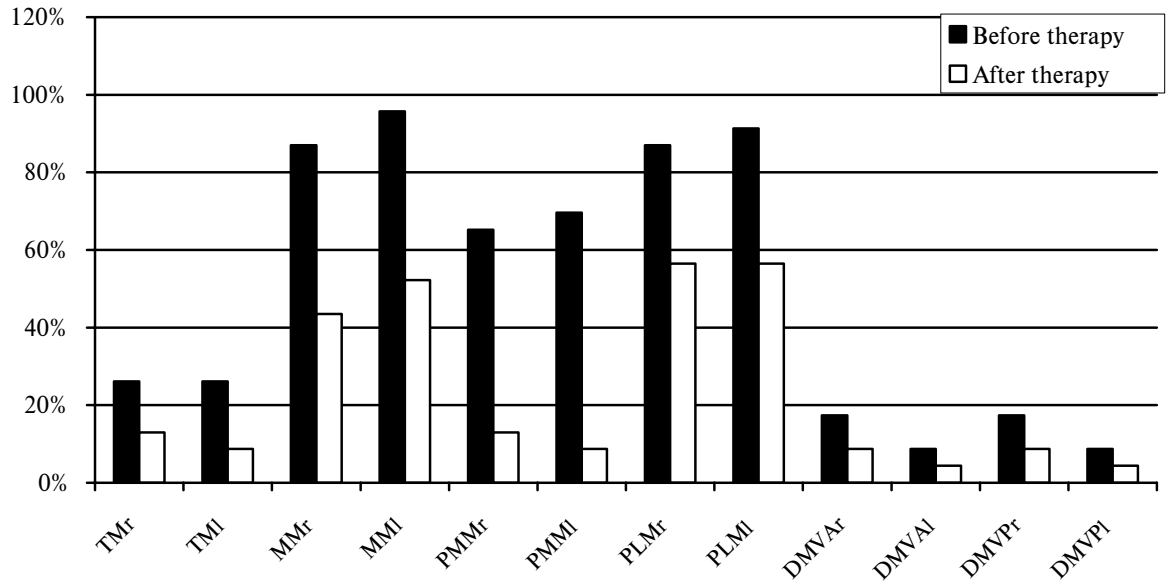
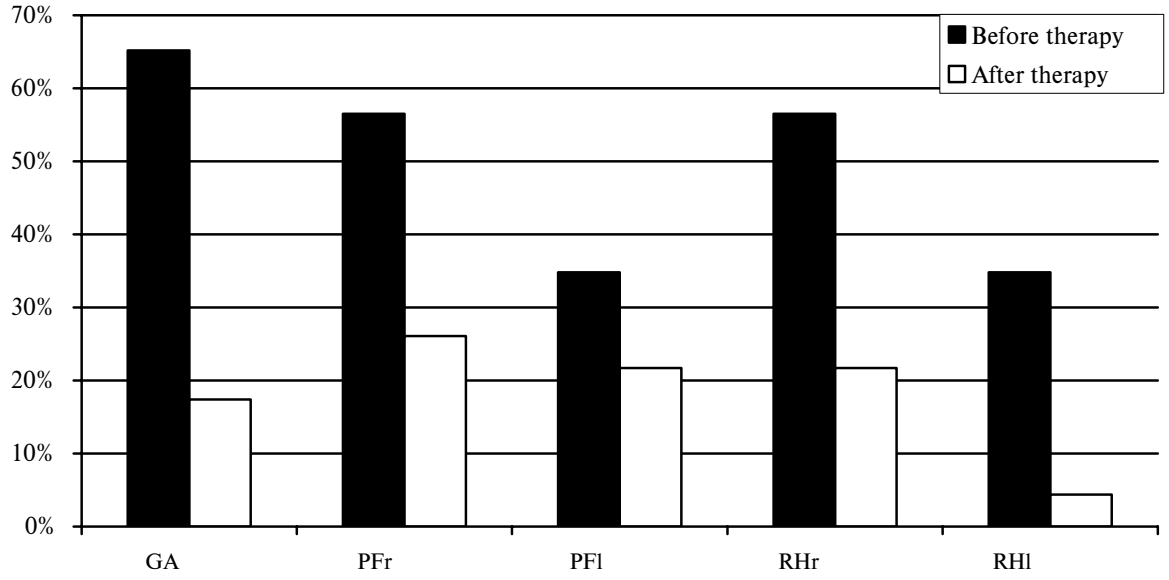


Fig. 4
Reflex changes in masticatory muscles before and after therapy



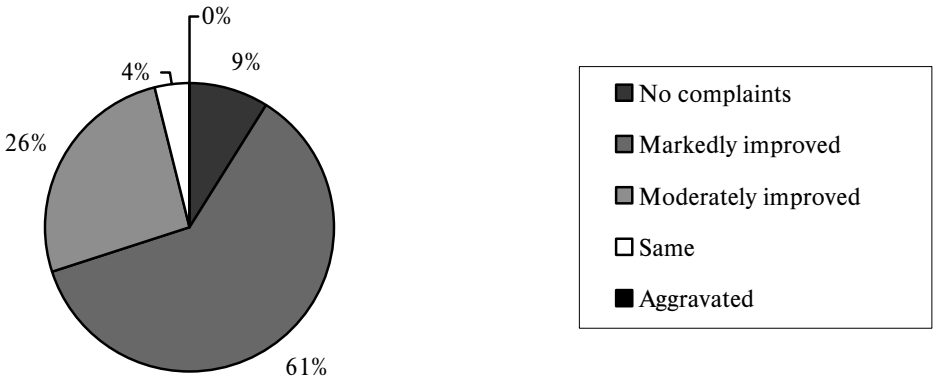
Legend: TMr – Temporalis muscle (right), TMl – Temporalis muscle (left), MMr – Masseter muscle (right), MMl – Masseter muscle (left), PMMr – Pterygoideus medialis muscle (right), PMMl – Pterygoideus medialis muscle (left), PLMr – Pterygoideus lateralis muscle (right), PLMl – Pterygoideus lateralis muscle (left), DMVAr – Digastricus muscle – venter anterior (right), DMVAl – Digastricus muscle – venter anterior (left), DMVPr – Digastricus muscle – venter posterior (right), DMVPl – Digastricus muscle – venter posterior (left).

Fig. 5
Reflex changes in fascias and restriction of movement of the hyoid before and after therapy



Legend: GA – Galea aponeurotica, PFr – Pretracheal fascia (right), PFl – Pretracheal fascia (left), RHr – Restriction of hyoid (right), RHl – Restriction of hyoid (left).

Fig. 6
Subjective assessment of the effect of specific physiotherapy by the patients



DISCUSSION

Anamnestic/medical historical data show that TMD develops most frequently after stomatological treatment during which the mouth was held wide open (e. g. extraction of molars, orthodontic interventions or dental implants). Early treatment not only clears up the disturbance but prevents deterioration and chronicity. Repeated stomatological treatment and/or keeping the mouth open for prolonged periods is a risk factor producing TMD (Hengeveld & Banks, 2005). The second most frequent factor was stress and psychological tension (Dimitroulis, 1998; Machoň & Lukášová, 2005; Pallegama, Ranasinghe, Weerasinghe, & Sitheeque, 2005; Velly, Gornitsky, & Philippe, 2002). In such cases the best treatment therefore is psychotherapy and individual physiotherapy with a sensitive approach to the patient. The third most frequent cause of TMD was a parafunctional disorder with occlusal contact. This is in agreement with the findings of other authors (Miyake, Ohkubo, Takehara, & Morita, 2004).

Parafunctional activities traumatize the TMJ and cause an increased activity and tension in the masticatory muscles with reflex changes and pain. In this way a vicious circle is established. This can be overcome by changing the patient's behaviour by self monitoring and by treatment which reduces muscular as well as mental tension due to parafunctional activity. The effect of the treatment was particularly striking in two patients after fracture of the mandible whose pain was dramatically reduced and the range of the mouth opening increased. Bruxism as an etiological factor in TMD was present only in 17.4% of the cases. This is in agreement with the literature (Machoň & Lukášová, 2005). It may be due to the fact that the patients are not aware of it.

The largest group of patients was made up of students and school children – 33.3%. This can be due to increased stress, especially in university students and in younger children during puberty or as a consequence of orthodontic treatment. Of patients, 19% were office workers, 19% had a job in which static and dynamic work was balanced and only 9.5% were physically active at work. Work under mainly static conditions, sitting with a forward drawn head and neck had no apparent effect on TMD. In women on maternity leave, hormonal changes may play a role and in the elderly, arthrotic changes at the TMJ may be implicated.

The most frequent symptoms in our patients were sound phenomena with a 95.6% occurence. They were of various origin and character. Some were absolutely benign, in particular as an isolated symptom without pain and movement restriction (Dimitroulis, 1998). Pain was the second most frequent symptom in 82.6% of the cases.

The most frequent reflex changes (trigger points – TrPs, tender points – TePs) in our group were found in the masseter muscle (in 91.3%), followed by the pterygoideus lateralis muscle (89.1%) and the pterygoideus medialis muscle (in 67.4%). This is in contrast with the study of Travell and Simons (1998) who found TrPs most frequently in the pterygoideus lateralis muscle (36%), in the pterygoideus medialis muscle (17%) and in the masseter muscle only up to 3%. This difference may be due to different pressure applied for palpation or different assessment of the taut band, TePs and TrPs.

The examination of soft tissue and mobility showed that there was a correlation between changes in the pretracheal fascia and the side of restricted movement of the hyoid. The movement of the hyoid was restricted towards the side opposite to the taut fascia. There was also a correlation between the side of atlanto-occipital (AO) movement restriction and a restriction barrier of the TMJ – TMJ was more frequently on the left. We can argue that there was a link between AO and TMJ movement restriction.

According to Travell and Simons (1998) myofascial trigger points are the most frequent cause of pain in the region of the TMJ. This was confirmed by our patients in whom compression of TrPs produced pain which corresponded to their spontaneous pain. This is further borne out by a reduction of pain from 4.2 to 0.7 points and by the cessation of tooth ache without stomatological cause which was reduced from the initial 47.8% to 13% after the treatment. It may be useful for stomatologists to know about painful changes in function. These are frequently ignored and the patient's pain of muscular origin is overlooked.

Restricted mobility of the mandible may be caused by an increased tension in the masticatory muscles or by a dislocation of the intraarticular disc, its anterior position interfering with the anterior glide of the mandibular condyles during opening of the mouth (Magee, 2002; Travell & Simons, 1998).

A high percentage of the patients suffered from a disturbance of hearing – tinnitus (ringing in the ears) and of one sided deafness. This may be caused by myofascial pain or by biomechanical changes in the mandibulocranial complex. If there are changes in the character and intensity of the tinnitus during mandibular movements, physiotherapy is likely to produce good results (Koneke C., Koneke A., Mangold, & Nowak, 2005).

A striking reduction of pain was achieved exclusively by manual mobilization, relaxation and soft tissue techniques applied to the TMJ, the cervical spine and its fascias, without drugs or other means of physical therapy. These techniques by themselves seem to have abolished the increased tension of the soft tissues in the region of the TMJ. Another important role is played by the elimination of pathogenetic factors causing pain by means of self control. This is also pointed out in recent studies (Hanáková, Jureček, & Konečný, 2005; Michelotti el al., 2005; Nicolakis et al., 2001; Nicolakis et al., 2002; Oh, Kim, & Lee, 2002) according to which the best biomechanical conditions can be achieved by relaxation, coordination and stabilization training.

The normal range of mouth opening is usually considered to be 35–50 mm (Gallagher C., Gallagher V., Whelton, & Cronin, 2004; Hoppenfeld, 1976; Magee, 2002). Less than 35 mm must be considered hypomobile, whereas more than 50 mm as hypermobile. The smallest range in our group was 18 mm which improved to 23 mm after the treatment. On the average the range of movement increased by 4.09 mm. Physiotherapy thus increases also the range of mandibular movement which is also born out by the literature (Hanáková, Jureček, & Konečný, 2005; Nicolakis et al., 2001, 2002; Oh, Kim, & Lee, 2002).

The effectivity of the treatment on the sounds produced by movements of the mandibula was clearly shown. These ceased completely in 18% of the cases while in the majority of cases the character of the sounds changed and the intensity of the sounds and the clicking were reduced and their frequency diminished, to the effect that they disappeared nearly completely at the time of mouth opening. The intensity of the sound phenomena was reduced by 56.7%.

After the treatment, 8.7% of the patients were entirely symptom free, 60.9% of them were very satisfied with individual physiotherapy, 26.1% indicated moderate improvement and 4.3% felt no change. Deterioration did not occur in any case. Improvement was thus achieved in 95.7% of the cases, with only 4.3% of them being neutral cases.

The improvement two months after the treatment and even further progress in some cases can be ascribed to continued home exercise, to consistent adherence to a healthy regimen producing further decrease of the tension in the region of the TMJ.

CONCLUSION

We found that physiotherapy is useful in treating TMD. The favourable results of this study are in agreement with data from the literature, where similar effects of relaxation, coordination and stabilization exercise of the TMJ are mentioned (Hanáková, Jureček, & Konečný, 2005; Michelotti et al., 2005; Nicolakis et al., 2001, 2002; Oh, Kim, & Lee, 2002). Individual physiotherapy in the early stages of dysfunction is the best prevention of a chronic course due to structural pathology. The treatment should not be limited to the region of the TMJ, but should take into account its relationship to other parts of the motoric system owing to chain reactions occurring in the motoric system as a rule. Dysfunctional chains have their key links which can be outside the orofacial system and may even cause TMD. This is important for the prevention of relapses.

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EFEKT CÍLENÉ REHABILITAČNÍ INTERVENCE PŘI LÉČBĚ TEMPOROMANDIBULÁRNÍCH PORUCH

(Souhrn anglického textu)

Cílem práce bylo zhodnotit vliv individuální fyzioterapie temporomandibulárních poruch (TMP) a ověřit trvání efektu terapie u těchto potíží po dvou měsících od ukončení individuální fyzioterapie. Bylo vyšetřeno 23 probandů, 17 žen a 6 mužů, s průměrným věkem 36,5 roku. Hodnocena byla účinnost individuální fyzioterapie na výskyt a intenzitu bolesti v oblasti temporomandibulárního kloubu (TMK), na rozsah abdukce v čelistním kloubu a na intenzitu zvukových fenoménů při pohybech dolní čelisti. Pacient byl nejdříve vyšetřen stomatologem, který po vyšetření doporučil individuální fyzioterapii. Efekt individuální fyzioterapie byl posuzován na změnách intenzity bolesti, na přítomnosti nebo absenci reflexních změn v měkkých tkáních žvýkacích svalů a m. digastricus, na změně velikosti otevírání úst a na intenzitě zvukových fenoménů při pohybech dolní čelisti. Po ukončení terapie jsme zjistili, že individuální fyzioterapie u TMP vede ke statisticky významnému ($p < 0{,}001$) snížení subjektivně vnímané intenzity bolesti v TMK – z 4,2 bodu na vizuální analogové škále (VAS) na 0,7 bodu. Došlo také ke snížení počtu reflexních změn ve svalech a fasciích. Po individuální fyzioterapii došlo také ke statisticky významnému ($p < 0{,}001$) zvětšení rozsahu abdukce v čelistním kloubu (z 37,3 mm na 41,3 mm) a ke statisticky významnému ($p < 0{,}001$) snížení intenzity zvukových fenoménů při pohybech dolní čelisti (z původních 100 % na 43 %). Dále jsme

prokázali přetrvávání efektu individuální fyzioterapie i další zlepšení po dvou měsících od ukončení terapie u těchto sledovaných charakteristik: intenzity bolesti ($p < 0,001$), rozsahu pohybu ($p < 0,003$) a zvukových fenoménů ($p < 0,001$).

Klíčová slova: temporomandibulární kloub, temporomandibulární porucha, individuální fyzioterapie.

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Musculoskeletal pain, proprioception.

First-line publications

Smékal, D., & Hillerová, R. (2004). An evaluation of the balance and adaptation mechanisms of patients with an injury of the anterior cruciate ligament (ACL). In F. Vaverka (Ed.), *Proceedings of the 3rd International conference Movement and Health* (pp. 344–347). Olomouc: Univerzita Palackého.

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