

The biomechanical and functional relationship between temporomandibular dysfunction and cervical spine pain

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The aim of this study was to investigate the influence of TMD on spinal pain and to check whether TMD therapy helps to cure spinal pain. The total number of 44 evaluated patients underwent physical examination of masticatory motor system, including an evaluation of TMJ function with a Zebris JMA device and an analysis of the cervical spine motion using a Zebris MCS device. Patients from the treated (tested) group, who were diagnosed with TMD, were treated with an occlusal splint. Subsequent examinations were planned 3 weeks and 3 months after the treatment. The results show that there is a close correlation between TMD and spinal pain. The results of the tests performed 3 months after the beginning of occlusal splint therapy show a significant improvement in TMJ function as well as a reduction in spinal pain, as general motor parameters of spinal movements improved.

Key words: back pain, temporomandibular joint disorders, bruxism, headache

1. Introduction

Recent years have seen a significant increase in the number of patients suffering from temporomandibular joint dysfunctions. According to various sources, 8 out of 10 patients coming to the dentist are found to have bruxism or TMD [1]. Pain is often the first symptom of TMD, and causes patients to look for medical advice. On average, TMJ is used around 1500–2000 times a day, so any pain can easily disturb daily activities [2], [3].

Pains can be divided into central, projected and referred [4]. In the case of referred pain, unpleasant sensations occur within the nerve affected by the pathological process, but are felt in the area controlled by the other branches or even a different nerve.

In a cranial nervous system, there is a triple neuron reflex way where the nerves are passing and penetrating each other. This is why patients suffering from

TMD usually feel pain in different regions, for example, in the ear, forehead, temples, back of the head, cervical spine and shoulder girdle, as well as in the thoracic, lumbar and sacral spine or legs [5], [16].

The presence of referred pain is the main reason leading patients to pay a visit to orthopedist, laryngologist or neurologist as a first choice of specialists. These physicians focus their therapy on the painful area, which does not eliminate (in this case) the source of pain [6]. Patients are directed from one doctor to another until, eventually, they visit their dentist, where the cause of their persistent pain is found to lie precisely in the masticatory motor system.

Besides pain, patients exhibit intraoral signs of dysfunction of the masticatory motor system such as abfraction and increased sensitivity, wear facets, pathological attrition, bone support loss and increased tooth mobility, but some patients also develop increased bone support in the form of bony ridges, tooth impressions on the tongue as well as linea alba on the

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buccal mucosa. Motor symptoms include limited range of mandible motion, deviation from the midline during movement, and popping or clicking sounds during the opening and closing of mouth.

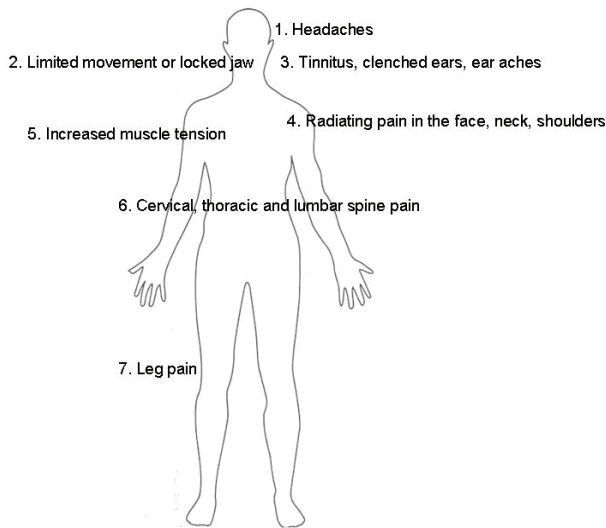


Fig. 1. Distribution of pain in a patient suffering from TMD

Patients may also experience hearing symptoms like noises and squeaks, or ocular signs such as visual disturbances and eye ache. Neck and shoulder stiffness and pain, as well as severe headaches, are also quite common [7], [8], [17].

The stomatognathic system (SS), more often replaced by the concept of the “upper quadrant”, which means the top of the spine and head, is an integral part of the musculoskeletal system.

That is the reason why all changes occurring within the structures responsible for human movement also affect the SS [9].

In addition, the principle of the body functioning as a whole is compensation, when disturbances occur in the upper quadrants, such as increased muscle tension. In such a case, compensatory changes take place in the muscle tension in the spine to force a correct position/posture. These adaptive changes occur on all levels and depend on the tolerance of the body [10], [11].

According to currently prevailing theories, etiopathogenesis of the masticatory dysfunction is associated with a local or general event (such as trauma, parafunctions), primarily with increased muscle tension and occlusion disorders (usually iatrogenic). Trauma (car accidents, stroke) should also be taken into account [12]. Occlusal imbalance in each case increases muscle tension, which usually results in generating joint disorders.

An additional factor that enhances the rise in the incidence of such ailments is omnipresent stress, which adversely affects the entire body.

The aim of this study was to evaluate the pain and mobility of the temporomandibular joints and cervical spine before occlusal treatment (by splint), 3 weeks and 3 months after receiving splint therapy. We also wanted to assess the severity and duration of TMD and spinal pain signs.

2. Materials and methods

Patients in the study were divided into two groups: test (treated with occlusal splint) and control (untreated). They met the criteria for inclusion in the examination or exclusion from them (table 1).

Every patient involved in this study was referred to an orthopaedist. Because TMD leads to a change of muscle tension in the upper quadrant of the body, this tension is transferred to adjacent areas and can cause spinal pain. Orthopaedists who carried out a preliminary examination of the patients had first to exclude congenital or degenerative changes of the spine which for instance could have been the reason of pain.

Each patient was examined three times. During the first examination a doctor gave the diagnosis of temporomandibular disorders. Patients from the treated group had also an impression (to make the occlusal splint) taken. The second examination was conducted 3 weeks later, and the third took place 3 months after the beginning of the therapy.

Table 1. Inclusion and exclusion criteria for studies

Inclusion criteria	Exclusion criteria
1. Spinal pain in anamnesis	1. Spine surgery in anamnesis
2. Women, men	2. Congenital or degenerative changes confirmed radiologically
3. Age between 18–60	3. Neuropathy
4. Functional changes of the spine	4. Ongoing medication or physiotherapy
5. Temporomandibular joint disorder, bruxism	
6. Patients agreement	

Each patient's examination included:

1. Anamnesis, based on a survey card.
2. The analysis of pain, using the VAS and the Oswestry scale concerning the lumbo-sacral spine.
3. Standard extraoral and intraoral examination, taking into account the masticatory motor system (e.g., muscle tenderness).
4. TMJ study using the Zebris JMA device.
5. Instrumental study of cervical spine motion with the Zebris MCS device.

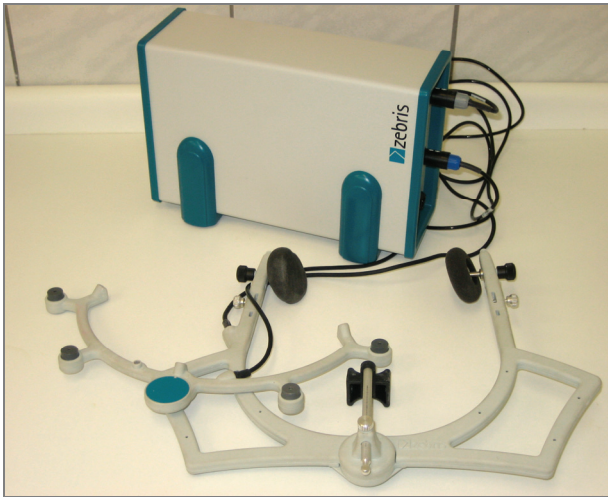


Fig. 2. Jaw movement analysis, Zebris: basic unit, face bow with receiver sensors, lower jaw, pointer sensor



Fig. 3. Patient during jaw movement analysis

The JMA Zebris device, used to study movements and action of TMJ, is composed of a base unit CMS20 JMA, the receivers of ultrasonic signals flowing from the markers, a set of snap-ins with ultrasound markers for mounting on the face bow and a jaw attachment, computer software WinJaw and a footswitch [13].

At the patient's head the upper arm was fitted (acting as a face bow), while the lower arm was fitted to the

attachment, which adheres closely to the atrial surface of the lower teeth. The study was based on the performance of patients' movements: opening and closing of the mandible, lateral movements, protrusion and retrusion.



Fig. 4. CMS10 measuring system

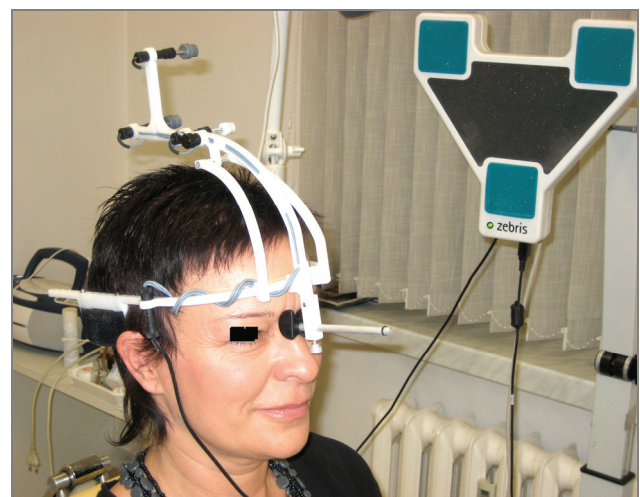


Fig. 5. Patient during cervical spine movement analysis

After completing the JMA study (TMJ), every patient was tested with the Zebris MCS device. An MCS kit consists of a base unit, the measuring head snap to attach ultrasound markers and reference markers to study the cervical spine, a tripod on wheels and Triple Win-Spine software [14]. Patients had the snap with markers placed on their heads. The snap was attached to the base unit. The patients positioned neutrally (comfortably seated) performed maximal head movements, i.e., flexion, extension and rotation to the right and left sides and lateral flexion movements to the left and right.

After examining the patient's movements, we received reports containing information about the qual-

ity and range of movement in both the TMJ and cervical spine.

After the first examination, each patient selected for the treated (tested) group was supplied with an occlusal splint which was matched individually, depending on the disease. In most cases, we supplied patients with an occlusal splint SVED (Sagittal Vertical Extrusion Device). SVED is a removable appliance which makes contact only with the anterior teeth in the opposing arch. It is a typical relaxation plate. It makes the posterior teeth disengaged and thus eliminates their influence on the masticatory system by changing the input signal from proprioceptive fibres found in the periodontal ligament of the posterior teeth. The SVED appliance is used in the case of hyperactivity of masticatory muscles, without the occlusal reason of TMD. It has an effect on the jaw muscles and the TMJ structures by affecting the muscles' working conditions and relaxing them. SVED is usually used

to promote jaw muscle relaxation in patients with stress-related pain symptoms like headache or neck pain of muscular origin. The splint also forces a new position of patient's mandible which results in a new muscular and articular balance and in getting by the articulator disc its antero-superior position over the condylar head.

3. Results

44 patients were tested, 26 belonging to the treated (tested) group and 18 to the untreated group. Patients were randomly admitted to the groups. During the first examination, increased masticatory muscle tension was reported on the left side of the head by 30 patients (18 from the treated group) and on the right side by 40 patients (24 from the treated group). After 3 months of therapy, increased muscle tension was noticed in 10 patients on the left side (all from the untreated group) and 14 patients on the right side (12 from the untreated group, only 2 from the treated group).

Disc displacement with reduction (DDR) was observed during the initial physical examination in 6 (4 from the treated group) patients on the left side and in 16 (8 from the treated group) patients on the right one. Three weeks after beginning the treatment with



Fig. 6. An occlusal splint – SVED

Table 2. Total number of people suffering from TMD at the 1st, 2nd and 3rd examinations

No. of examination	Increased muscle tension, left side	Increased muscle tension, right side	DDR, left side	DDR, right side	Headache
1st examination	30	40	6	16	36
2nd examination	16	28	4	10	28
3rd examination	10	14	2	8	20

Table 3. Total number of patients suffering from spinal pain at the 1st, 2nd and 3rd examinations

No. of examination	Cervical spine pain	Thoracic spine pain	Lumbo-sacral spine pain
1st examination	34	18	30
2nd examination	24	12	24
3rd examination	14	8	14

Table 4. Number of patients with changes of spine pain during the third examination

Pain characteristic	Treated group		Untreated group	
Spine pain remained the same	0	0%	14	77.8%
Spine pain increased	0	0%	2	11.1%
Spine pain decreased	16	61.5%	2	11.1%
Spine pain disappeared completely	10	38.5%	0	0%

occlusal splint, DDR was recorded in 4 (2 from the treated group) and in 10 (2 from the treated group) patients, whereas after 3 months, it was noted in only 2 patients on the left side (all of them from untreated group) and in 8 patients on the right side (6 from the untreated group, 2 from the treated group).

Headaches were initially reported by 36 patients (20 from the treated group) which was 88% of all the patients examined. After 3 weeks, 28 (12 from the treated group) patients experienced headaches, and after 3 months of treatment only 20 (4 from the treated group) patients still suffered from them. In the treated patients still suffering from pain (4) its intensity decreased significantly.

34 patients reported cervical spine pain (18 from the treated group). After 3 weeks of treatment, pain was experienced by 24 (10 from the treated group) patients and after 3 months of therapy, pain was still experienced by 14 patients (only 2 from the tested group).

Thoracic spine pain was felt by 18 (6 from the treated group) patients, their number decreased after 3 weeks to 12 (6 from the treated group) patients, and after 3 months to 8 patients (6 in the untreated group, 2 in the treated group).

30 (16 from the treated group) patients suffered from lumbo-sacral pain. After 3 weeks their number decreased to 24 (12 from the treated group) and after 3 months to 14 patients (12 in the untreated group, 2 in the treated group).

The general motor parameters of spinal movements showed a significant improvement in the treated group. During the first examination the range of cervical spine motion (ROM) was limited in most patients (ROM was limited compared to the limits of physiological norm). After 3 months of treatment the ranges of cervical spine motion conformed to a physiological norm. Patients also reported an improvement in ROM and pain relief during movements.

In addition to improving the performance of functional movements in the study, patients reported no need to use painkillers and a significant improvement in overall well-being, as reflected in the Oswestry scale.

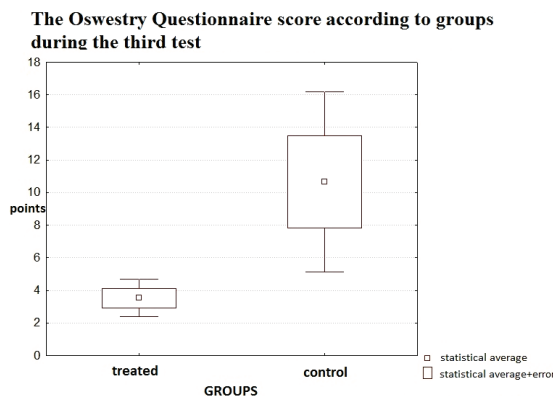


Fig. 7. The Oswestry Questionnaire score according to groups during the third test

4. Discussion

Disorders (TMD) usually occur because of unbalanced activity, spasm or overuse of the jaw muscles and incorrect tooth occlusion. Symptoms tend to be chronic, and treatment is aimed at eliminating the precipitating factors. Usually the first symptom making patients prone to calling on doctor is pain in the masticatory motor system, but also shoulder girdle pain, limb and spinal pain.

Patients often consult a laryngologist first because of ear problems (ear pain, fullness of ear, tinnitus), a neurologist because of craniofacial pain or go to a pain clinic. However, they do not respond well to the treatment received because the cause of pain lies in the stomatognathic system and is not found.

Many authors draw attention to the correlation between temporomandibular dysfunction and pain in different regions of the body [2], [3], [9], [10], [15], [17]–[19].

We have found no studies that objectively prove the positive effects of TMD therapy on spinal pain. So far, the research has focused only on proving the correlation between spine pain and TMD.

The studies by Wiesinger et al. (2007) involved a total of 280 patients aged between 20 and 62, reporting back pain. All filled out a questionnaire on symp-

Table 5. Total number of patients with limited mobility of the cervical spine during different movements. Data collected from the studies by MCS Zebris device

No. of examination	Limited ROM Anteflexion	Limited ROM Retroflexion	Limited ROM Rotation R	Limited ROM Rotation L	Limited ROM Lateral flexion R	Limited ROM Lateral flexion L
1st examination	20	4	10	10	10	12
2nd examination	14	4	8	6	4	8
3rd examination	12	2	6	6	4	8

toms and underwent spinal research (the study of the temporomandibular joints, masticatory muscles, and track and field analyses of the abduction of the mandible). The research revealed that patients suffering from chronic spinal pain more often felt pain around the upper quadrant than the control group [9].

The same researchers (2009) examined a much larger group (616 patients) with clear symptoms of spinal pain and dysfunction of the masticatory system. The analysis of results indicated that different segments of spinal pain were present in only 30% of patients in TMD “group 0” (without signs of TMD) but in 68% of patients in TMD “group 3” (patients with chronic, severe ailments due to temporomandibular joints disorders).

What distinguishes our study from another is the measurement of cervical spine movements by an ultrasound device (the Zebris CMS), thereby evaluating in an objective way the improvement in movement performance after introducing an occlusal treatment. The study was repeatable and not invasive.

We measured the parameters of spinal motion 3 weeks and 3 months after the beginning of occlusal treatment with an occlusal splint SVED. During the last examination the range of cervical spine motion was much better and fit the physiological norm in most cases.

In the case of TMD, therapists often hold widely differing views on the type of occlusal splint most appropriate to use. Many types of splints can be mentioned, for example, stabilization splint, repositioning splint, relaxation splint or splints only for protecting oral tissues. In our study, the commonest SVED splint, a typical relaxing appliance, was used because of its influence on jaw muscles. No studies on different types of the splints used in patients with both TMD and spinal pain were found.

Our research has shown that the treatment of temporomandibular dysfunction by an occlusal splint SVED has a positive effect on spinal pain relief, as was reflected in the Oswestry scale. As a result of the correct diagnosis and treatment administered, the parameters of posture and/or function of the temporomandibular joints, measured by the Zebris MCS and JMA devices, have changed. Patients in the study group during the anamnesis showed improvement, which also testified to the advisability of the therapy applied.

Taking into account the results of our study it seems obvious that interdisciplinary cooperation between orthopedist, laryngologist, neurologist and dentist is necessary and essential.

References

- [1] STOHLER C.S., *Muscle-related temporomandibular disorders*, J. Orofac. Pain, 1999, 13, 273–284.
- [2] VALENTINO B., MELITO F., ALDI B. et al., *Correlation between interdental occlusal plane and plantar arches. A EMG Study*, Bull. Group Int. Rech. Sci. Stomatol. Odontol., 2002, 44, 10–13.
- [3] SAITO E.T., AKASHI P.M., SACCO IDE C., *Global body posture evaluation in patients with temporomandibular joint disorder*, Clinics (Sao Paulo), 2009, 64(1), 35–39.
- [4] OKESON J.P., *Leczenie dysfunkcji narządu żucia i zaburzeń żwarcia*, Lublin, 2005.
- [5] BALASUBRAMANIAM R., de LEEUW R., ZHU H., NICKERSON R.B. et al., *Prevalence of temporomandibular disorders in fibromyalgia and failed back syndrome patients: a blinded prospective comparison study*, Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 2007, 104(2), 204–216.
- [6] MACHADO L.P., NERY CDE G., LELES C.R. et al., *The prevalence of clinical diagnostic groups in patients with temporomandibular disorders*, Cranio, 2009, 27(3), 194–199.
- [7] KRAUS S., *Temporomandibular disorders, head and orofacial pain: Cervical spine considerations*, Dent. Clin. North Am., 2007, 51, 161–193.
- [8] PEDRONI C.R., de OLIVEIRA A.S., BÉZIN F., *Pain characteristics of temporomandibular disorder: a pilot study in patients with cervical spine dysfunction*, J. Appl. Oral Sci., 2006, 14(5), 388–392.
- [9] WIESINGER B., MALKER H., ENGLUND E. et al., *Does a dose-response relation exist between spinal pain and temporomandibular disorders? BMC Musculoskelet. Disord.*, 2009, 2, 10, 28.
- [10] LIPPOLD C., DANESH G., SCHILGEN M. et al., *Sagittal jaw position in relation to body posture in adult humans – a rasterstereographic study*, BMC Musculoskelet. Disord., 2006, 31, 7, 8.
- [11] RIES L.G., BÉZIN F., *Analysis of the postural stability in individuals with or without signs and symptoms of temporomandibular disorder*, Braz. Oral Res., 2008, 22(4), 378–383.
- [12] DUPAS P.-H., *Dysfunkcja czaszkowo-żuchwowa*, Warszawa, 2009.
- [13] ENCISO R., MEMON A., FIDALEO D. et al., *The virtual craniofacial patient: 3D jaw modeling and animation*, Stud. Health Technol. Inform., 2003, 94, 65–71.
- [14] VOGT L., SEGIETH C., BANZER W., HIMMELREICH H., *Movement behaviour in patients with chronic neck pain*, Physiother. Res. Int., 2007, 12(4), 206–212.
- [15] CROFT P., DUNN K., Von KORFF M. et al., *Chronic pain syndromes: You can't have one without another*, Pain, 2007, 131, 237–238.
- [16] PERINETTI G., *Correlations between the stomatognathic system and body posture: biological or clinical implications*, Clinics (Sao Paulo, Brazil), 2009, 64(2), 77–78.
- [17] JABER J.J., LEONETTI J.P., LAWRASON A.E. et al., *Cervical spine causes for referred otalgia*, Otolaryngology – Head + ACY – Neck Surgery, Apr. 2008, 138(4), 479–485.
- [18] PLESH O., ADAMS S.H., GANSKY S.A., *Temporomandibular joint and muscle disorder-type pain and comorbid pains in a national US sample*, J. Orofac. Pain, 2011, 25(3), 190–198.
- [19] CATANZARITI J.F., DEBUSE T., DUQUESNOY B., *Chronic neck pain and masticatory dysfunction*, Joint Bone Spine, Dec. 2005, 72(6), 515–519.