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Correlation between cervical spine and temporomandibular disorders

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Abstract Neuroanatomical interconnections and neurophysiological relationships between the orofacial area and the cervical spine have been documented earlier. The present single-blind study was aimed at screening possible correlations between clinical signs of temporomandibular disorders (TMD) and cervical spine disorders. Thirty-one consecutive patients with symptoms of TMD and 30 controls underwent a standardised clinical examination of the masticatory system, evaluating range of motion of the mandible, temporomandibular joint (TMJ) function and pain of the TMJ and masticatory muscles. Afterwards subjects were referred for clinical examination of the cervical spine, evaluating segmental limitations, tender points upon palpation of the muscles, hyperalgesia and hypermobility. The results indicated that segmental limitations (especially at the C0–C3 levels) and tender points (especially in the m. sternocleidomastoideus and m. trapezius) are significantly more present in patients than in controls. Hyperalgesia was present only in the patient group (12–16%).

Key words Cervical spine · Temporomandibular disorders · Functional limitations

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Introduction

Interrelationships between the orofacial area and the cervical spine have been documented both at the neuroanatomical and neurophysiological levels [for review see 1]. Sensory information from the cervical spine converges with trigeminal afferents within the spinal tract of the trigeminal nucleus, while fibres arriving in the subnucleus caudalis descend further down to C2–C3 [2] and even C6 [3]. The superficial sensory distribution of the upper cervical nerves (the ventral cervical roots 2 and 3) also comprises parts of the face, especially the mandibular angle [4].

Some studies have tried to elucidate the coexistence of jaw pain and neck pain, as commonly reported by clinicians [5–7], or to explain the mechanisms of referred pain from the neck to the face [8]. Significant associations between the functional state of the stomatognathic system and both mobility of the cervical spine and neck–shoulder tenderness were reported in patients suffering from occupational cervicobrachial disorder [9, 10]. Another study evaluated 40 consecutive temporomandibular disorder (TMD) patients using a questionnaire and clinical examination of both the masticatory system and the cervical spine and compared the results with an age- and gender-matched control group [11]. Unfortunately, the examinations were not performed under blind conditions with regard to the classification of the subject/patient. The results indicated that patients at a TMD clinic were significantly more likely to have craniocervical signs and symptoms than non-patients, and this was confirmed in later reports [12, 13]. More recently, a group of TMD patients was compared with a group of patients with cervical spine disorders (CSD) [14]. The TMD patients were classified in subgroups (myogenous, arthrogenous or mixed TMD) according to clear inclusion and exclusion criteria. An extensive standardised clinical interview and examination regarding CSD was performed on all patients. The TMD patients differed from the CSD patients mainly with regard to palpation tenderness of the neck muscles, movement pattern of the lower cervical spine and pain on upper cervical rotation. These variables correctly classified 65% of the patients in their respective groups. The presence of signs and symptoms of CSD in TMD patients as compared to controls, however, remained unclear.

The aim of the present study, therefore, was to evaluate and compare signs and symptoms of TMD and craniocervical dysfunction using a controlled, single-blind design.

Materials and methods

Subject selection

Subjects belonged either to the test or the control group (status). The test group consisted of 31 consecutive new patients seeking care in the TMD clinic for signs and symptoms of a temporomandibular disorder. For inclusion, a subjective complaint of the masticatory system had to be present [pain from the temporomandibular joint (TMJ) or masticatory muscles, limitation of movement and/or interference during movements of the mandible]. This disorder had to be previously untreated, nor had any evaluation or treatment for cervical problems been installed in the past. Patients with general joint disease, posttraumatic complaints, fractures or congenital disorders were excluded. The group consisted of 24 females and 7 males, ranging from 21 to 59 years, mean age 36.4 years (SD 13.5 years); all gave informed consent for participation in the study, for which permission was granted by the Ethics Committee.

The control group was composed of students, staff members and patients attending other departments. They had to be free from subjective complaints of TMD or cervical dysfunction and willing to participate in the study. The control group consisted of 23 females and 7 males, ranging in age from 15 to 67 years, mean age 32.3 years (SD 13.7 years).

Examination of the stomatognatic system

All subjects underwent a standardised clinical examination of the masticatory system by a trained examiner. Assisted (passive) mouth opening was measured as the interincisal distance using a plastic ruler and after the subjects had performed the movement a few times. Similarly, laterotrusion left and right, and protrusion were registered. Mouth opening and protrusion were corrected by adding the overjet or overbite, respectively. In a few cases, the measurements were repeated at the end of the clinical examination and the registrations appeared reproducible within the range of 2 mm. Clicking sounds during mandibular movement (clicking of the TMJ) were examined manually and registered as anterior disc displacement with reduction left or right TMJ. The TMJ were palpated both laterally and posteriorly (while the subject performed protrusion of the mandible). Subjects were asked to rate the feeling as “pain” or “just pressure”; only the answer pain was considered a positive finding. To avoid overlap with the functional examination of the cervical spine, only the temporalis, masseter, medial pterygoid and the region of the lateral pterygoid muscle were palpated intra- and extra-orally, during the examination of the stomatognatic system. Only pain in one of the palpated sites was rated positive. The pressure exerted by manual palpation appeared to be ±1.5 kg/cm^2 when evaluated regularly through the aid of a balance.

Examination of the cervical spine

All participants were sent to the Physical Medicine Department for examination. They were first seen by an assistant for anamnesis. Afterwards, an independent, trained examiner, who was blind to the status (patient/control) of the subject, performed the examination. The examination was based on both a biomechanical model and a model for referred pain investigation [15]. The purpose of passive segmental mobility testing is to evaluate specific movements at each spinal motion segment or motion unit. Segmental mobility testing is performed passively by digital palpation of the facet joints, spinous and transverse processes and interspinous spaces. Criteria for grading segmental motion involves the range of motion and the resistance to motion. In this way, a qualitative analysis of resistance to passively induced motion is obtained, which is graded according to a 4-grade scale (1 = no movement, 2 = stiffness, 3 = normal movement, 4 = hypermobility). In this way, functional limitation of the first (C0–C1), second (C1–C2), third (C2–C3) and lower (C3–Th4) cervical joints was registered, as well as general hypermobility of the cervical spine. Manual palpation of the dermatomes and muscles, together with a skin-folding test [16] provided information on the presence of regional hyperalgesia (left/right) and tender points. The skin-rolling technique is used for the search of dermatomal hyperalgetic zones, irritated and tender areas, and trigger points in the m. trapezius, m. sternocleidomastoideus or other neck and shoulder muscles. The other neck and shoulder muscles investigated were the m. scalenus, m. levator scapulae, m. obliquus superior and inferior, m. rectus maior and minor.

Statistical analysis

Associations between discrete variables were evaluated using the odds ratio and the chi-square test. A significant odds ratio is defined as an upper and lower 95% confidence limit not containing the value 1. Values <1 indicate a negative association between the two investigated variables, values >1 indicate a positive association.

The level of significance was set at 0.05 and a Bonferroni correction was applied to prevent the possibility of a type I error (i.e. finding a correlation by chance due to the multiple testing).

Results

The prevalences of the variables in both the test and control groups, the odds ratio and the level of significance are summarised in Table 1. The evident significant differences concerning muscle and TMJ pain upon palpation of the masticatory system confirm the selection procedure.

Even after Bonferroni’s correction for multiple testing, it was apparent that significantly more segmental limitations in the high cervical region (C0–C1, C2–C3, see Fig. 1a) and tender points (left and right trapezius muscles, right sternocleidomastoid muscle and other muscles at the right) were present in the test group (Fig. 1b). Differences concerning the presence of TMJ sounds and hypermobility of the cervical spine were non-significant. Moreover, hyperalgesia, as tested using a skin-folding test, was present in 13–16% of subjects in the test group and in none of the controls.

Discussion

The present study evaluated the presence of signs of CSD in a TMD population as compared to a matched control group, using a single-blind design. From the results it was apparent that TMD patients exhibit significantly more segmental limitations, especially in the high cervical re-

Table 1 Prevalences (%), odds ratio and level of significance in the test and control groups (*TMJ Pain* pain upon palpation of the temporomandibular joint, *MYO Pain* pain upon palpation of the masticatory muscles, *ADDR* anterior disc displacement with reduction, C0–C1, C1–C2, … functional limitations at the levels C0–C1, C1–C2, …, *TP SCM* tender points in the sternocleidomastoid muscles, *TRAP* trapezius muscle, *Other* other neck and shoulder muscles, *L* left, *R* right)

Variable	Test (*n* = 31)	Control (*n* = 30)	Odds ratio	*P* value
TMJ Pain L	32.3	3.3	13.81	0.004
TMJ Pain R	38.7	3.3	18.32	0.001
MYO Pain L	74.2	3.3	83.37	0.000
MYO Pain R	83.9	10.0	46.80	0.000
ADDR L	9.6	13.3	0.70	0.657
ADDR R	12.9	6.7	2.07	0.417
CO–C1	76.7	20.0	13.14	0.000
C1–C2	50.0	16.7	5.00	0.007
C2–C3	93.3	36.7	24.18	0.000
C4–Th4	77.4	46.7	3.92	0.014
TP SCM L	23.3	6.7	4.26	0.073
TP SCM R	46.7	13.3	5.69	0.005
TP TRAP L	43.3	16.7	3.82	0.025
TP TRAP R	66.7	26.7	5.50	0.002
TP Other L	22.6	6.7	4.08	0.082
TP Other R	58.1	16.7	6.92	0.001
Hyperalgesia L	12.9	0.0	9.98	0.044
Hyperalgesia R	16.1	0.0	12.66	0.023
Hypermobility	9.7	10.0	0.96	0.967

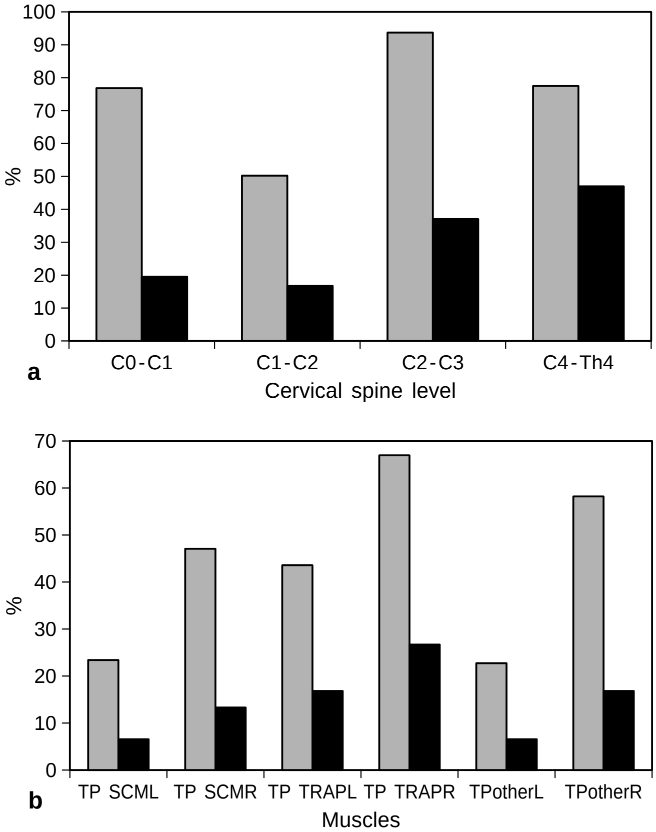

Fig. 1 **a** Prevalence of functional limitations of the cervical spine in test (*light bars*) and control (*dark bars*) groups (*C0–C1, C1–C2, C2–C3* functional limitation at levels C0–C1, C1–C2, C2–C3, respectively, *C4–Th4* functional limitations at the lower cervical and thoracic levels). **b** Prevalence of tender points on palpation of neck muscles (*TP* tender point, *SCML, SCMR* m. sternocleidomastoideus left and right, *TRAPL, TRAPR* m. trapezius left and right, *otherL, otherR* other muscles)

gion, and also report significantly more tender points upon palpation of the shoulder and neck muscles. The coexistence of signs and symptoms of TMD and CSD may be interpreted in several ways. One could consider the temporomandibular system and the cervical spine as a functional entity. Concomitant pain and dysfunction of the cervical spine could also result from changes in head posture, linked to a dysfunctional masticatory system [17]. From a neurophysiological point of view, the extensive convergence of different types of afferent input on the trigeminal nuclei [18], and more recent findings on neuronal plasticity [19], might account for the observed findings.

Previous studies focusing on TMD and CSD, although using a different design, came to similar conclusions as the present one. Alanen and Kirveskari [9] investigated a group of 141 female non-patients and found 51% of them to have some signs or symptoms of TMD. Comparing the group with symptoms and without symptoms with regard to craniocervical problems, they found 71% of CSD in the TMD group and only 40% in the non-TMD group. The high prevalence of functional limitations, even in the control group, was parallel to the present findings. In a subsequent study, these authors compared two patient groups seeking care for neck and shoulder problems with a non-patient sample [10]. It appeared that signs of TMD were present in 90.7% of the patient group and 82.5% of the control group, which sheds some doubt on the specificity of the examination methods of the stomatognatic system used. In the present study, tenderness upon palpation of the neck muscles was only rarely present in the control group, as has already been reported [12]. In contrast to their study, however, cervical muscle tenderness was present in 23–67% of the present patient sample.

The present results are probably best compared to the study of Clark et al. [11], which also investigated a group of patients seeking care for TMD, applied clear inclusion/exclusion criteria, a matched control group, and a separate examination of the masticatory system and the cervical spine by investigators trained for that area. Unfortunately, the physiotherapist involved in their study was not blind to the status of the investigated subject. The examination of the cervical spine comprised the evaluation of the head and neck posture, the range of motion of the head in different directions, the palpation of soft tissues and bony landmarks and verbal report of cervical noises during movement or neurosensory alterations. Only the palpation of the soft tissues appeared significantly different between the two groups, as was found in the present study. The functional examination of the cervical spine, as performed in the present study, aims at defining the level at which the limitation takes place. It was apparent from the present results that significantly more such limitations were present in the patient group, especially in the the upper cervical region (C0–C3).

It was striking that a positive response to the skin-folding test [16], used to evaluate hyperalgesia in the dermatomes involved, was only found in the patient group and not in the control group. This very high specificity, however, is countered by a low sensitivity (only 13–16% of the patients described the test as painful). Nevertheless, this finding merits further study in view of the recent findings regarding central and peripheral neuronal sensitisation [19].

Conclusions

The present results confirm the coexistence of signs of TMD and functional limitations, tender points and hyperalgesia in the cervical spine area. Both local interactions and central neuronal plasticity might account for the observed associations, as well as a general predisposing musculoskeletal factor in the patients.

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