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Analysis of stimulus-evoked pain in patients with myofascial temporomandibular pain disorders

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Abstract

The pathophysiological mechanisms of myofascial temporomandibular disorders (TMD) are still under investigation. The hypothesis that TMD pain is caused by a generalized sensitization of higher order neurons in the nociceptive pathways combined with a decreased efficacy of endogenous inhibitory systems has recently gained support in the literature. This study was designed to further investigate the somatosensory sensibility within and outside the craniofacial region. Twenty-two patients fulfilled the research diagnostic criteria for TMD for myofascial pain (Dworkin and LeResche, J Craniomandib Disord Facial Oral Pain 6 (1992) 301) and 21 age- and sex-matched subjects served as a control group. The somatosensory sensibility to a deep tonic input was tested by standardized infusions of hypertonic saline into the masseter and anterior tibialis muscle. Furthermore, pressure pain thresholds (PPTs) and heat pain thresholds (HPTs) were assessed with phasic stimuli at the same sites before and following the infusions. Myofascial TMD patients reported infusion of hypertonic saline to be more painful on 10 cm visual analogue scales (peak pain 8.8 ± 0.4 cm) than control subjects (6.8 ± 0.5 cm, *t*-test: $P = 0.003$) in the masseter but not in the anterior tibialis (7.4 ± 0.5 vs. 6.6 ± 0.5 cm, $P = 0.181$). The perceived area of experimental masseter pain measured on drawings was marginally larger in TMD patients (2.6 ± 0.5 arbitrary units (a.u.)) than in control subjects (1.4 ± 0.2 a.u., Mann–Whitney: $P = 0.048$) but no differences were observed for the anterior tibialis ($P = 0.771$). The PPTs were lower in the myofascial TMD patients compared to the control group, both in the masseter (analysis of variance (ANOVA): $P = 0.002$) and in the anterior tibialis ($P = 0.005$), whereas there were no significant differences in HPT (ANOVAs: $P = 0.357$, $P = 0.101$). There were no significant correlations between measures of somatosensory sensibility and measures of clinical pain intensity, pain duration, graded chronic pain scores or somatization or depression scores (Pearson: $R < 0.304$, $P > 0.172$). The present study in a well-defined group of myofascial TMD patients found that the responsiveness to both tonic and phasic deep stimuli, but not to phasic superficial inputs at the pain threshold level, in the craniofacial region was higher compared with a control group. These findings suggest that myofascial TMD pain is associated with a facilitation of stimulus-evoked pain primarily, but not exclusively related to the painful region.

Keywords: Human experimental muscle pain; Pressure pain thresholds; Thermal heat pain thresholds; Trigeminal pain mechanisms; Temporomandibular disorders

1. Introduction

Systematic investigations of somatosensory sensibility in patients with temporomandibular disorders (TMD) pain are scarce even though psychophysical analysis may provide important information about the underlying pathophysiological mechanisms. Woolf et al. (1998) suggested a new classification scheme for chronic pain conditions based on the mechanisms involved. According to this proposal, a thorough psychophysical examination will be needed to address the question of stimulus-evoked pain. Maixner et al. (1998) have shown that pressure pain thresholds (PPTs) are lower in both masticatory muscles and in extra-trigeminal regions in myofascial TMD patients compared with control subjects. Furthermore, heat pain thresholds (HPTs) on the forearm are lower and TMD patients demonstrate enhanced temporal integration of thermal pain compared with control subjects (Maixner et al., 1995, 1998).

Nevertheless, controversies relating to the direction and magnitude of somatosensory changes have arisen because

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other studies on PPTs and HPTs in extra-trigeminal regions did not show significant differences between TMD patients and control subjects (Price and Harkins, 1987; Svensson et al., 1995; Carlson et al., 1998). Decreased responsiveness to electrical stimuli applied to the skin above the masseter muscle (Hagberg et al., 1990) and lowered discriminability of vibrotactile stimuli (Hollins et al., 1996; Hollins and Sigurdsson, 1998) have also been reported in TMD patients. For patients with tension-type headache changes in craniofacial and extra-trigeminal somatosensory sensibility have been suggested to be related to the chronicity of the painful condition and the daily levels of pain (Jensen, 1999). Thus, chronic tension-type headache patients seem to have more severe and generalized disturbances in somatosensory function compared to episodic tension-type headache patients.

The test stimuli used for quantitative psychophysical examination of TMD patients have predominantly been phasic (a few seconds) stimuli applied to the skin (e.g. thermal, electrical, tactile) or transcutaneously (e.g. pressure stimuli). In psychophysical terms, painful stimuli lasting less than 3–7 s have been considered phasic (Rainville et al., 1992). Few studies in TMD patients have so far employed a more tonic experimental stimulus (Maixner et al., 1995), which may mimic clinical pain better. Stohler and Kowalski (1999) demonstrated the perceptual similarity between chronic myalgia and tonic pain evoked by hypertonic saline infusions in healthy volunteers. The hypertonic saline stimulus has recently been used to test the responsiveness to deep, tonic inputs in patients with various forms of musculoskeletal pain conditions, e.g. fibromyalgia and whiplash syndrome (Sörensen et al., 1998; Koelbaek Johansen et al., 1999). Another advantage, besides the perceptual and qualitative similarity to clinical pain, is that infusion of hypertonic saline allows a temporal profile of pain and maps of the spatial distribution of pain to be recorded.

The aim of the present study was to test the hypothesis that a well-defined group of TMD patients with myofascial pain have a generalized hypersensitivity to both tonic and phasic experimental test stimuli applied within as well as outside the craniofacial region.

2. Materials and methods

2.1. Study population

A total of 43 individuals were enrolled in the study and divided into two groups. The first group consisted of 22 patients from the TMD Unit at the Specialist Center for Oral Rehabilitation in Linköping, Sweden. The control group consisted of 21 general dentistry recall patients from a public dental clinic in Linköping. TMD patients and control subjects were closely matched with respect to gender and age. The local ethics committee approved the study and all individuals gave their informed consent in accordance with the Helsinki Declaration.

The inclusion criteria for the TMD group were (1) a primary diagnosis of myofascial pain according to the research diagnostic criteria (RDC) for TMD (RDC/TMD) (Dworkin and LeResche, 1992), (2) pain involving the masseter muscle, (3) a duration of pain of at least 6 months, and (4) an intensity of pain corresponding to a weekly average of at least 3 cm on a 10 cm visual analogue scale (VAS). The inclusion criterion for the control group was no myofascial TMD pain diagnosis according to the RDC/TMD. For both groups, the exclusion criteria were rheumatoid arthritis, systemic lupus erythematosus, psoriatic arthritis, fibromyalgia, whiplash injury, and an age of less than 18 years.

2.2. TMD examination

The RDC/TMD history questionnaire in Swedish was used (List and Dworkin, 1996). Questions about age and gender served to describe the study population. The average pain intensity was assessed on a 10 cm VAS. Temporal patterns of TMD-related pain and symptoms, pain localization, joint sounds, locking and catching of the temporomandibular joint (TMJ), tiredness and stiffness of the jaw, and parafunctional habits were reported on dichotomous scales. Psychological status was assessed by measuring the depression score and the non-specific physical symptoms score with subscales of the symptom checklist-90, revised (SCL-90R) (Derogatis, 1983). Psychosocial functioning was assessed using the graded chronic pain scale, which yields a score of 0–4 (0, no pain; 4, severe psychosocial dysfunction). The scale reflects the severity and impact of TMD on psychosocial functioning at home, work, or school and incorporates disability days lost due to TMD pain (Von Korff et al., 1992).

In addition, all subjects were asked to fill out a Swedish version of the McGill Pain Questionnaire (MPQ) and to draw the distribution of any type of persistent pain on maps showing the frontal and rear views of the body. Nine body regions were distinguished as previously described (Türp et al., 1997). Whenever one of these regions was part of the drawing, the region was counted as being in pain. The pain rating index (PRI) of the sensory, affective, evaluative, and miscellaneous dimensions of pain was calculated according to Melzack (1975) and the words chosen by at least 30% of the group were noted.

The following signs and symptoms were assessed using the RDC/TMD examination form: pain site; mandibular range of motion (millimeters) and associated pain (jaw opening pattern, unassisted opening without pain, maximum unassisted opening, maximum assisted opening, mandibular excursive and protrusive movements); sounds from the TMJ; and tenderness upon muscle and joint palpation (Dworkin and LeResche, 1992).

Finally, a routine neurologic screening examination was conducted comprising tests of the facial and hypoglossus nerve function, spontaneous nystagmus, gaze-nystagmus,