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ARTICLE

Association between signs of hyperalgesia and reported frequent pain in jaw-face and head

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ABSTRACT

Objective: To analyze the relationship between different sites of elicited pain to muscle palpation (PtP), and reported frequent pain in jaw-face and head.

Materials and methods: The analysis was based on an epidemiological sample of 1200 randomly selected individuals, of which 779 (65%) both completed a questionnaire and participated in a clinical examination. The questionnaire addressed the presence of pain in the jaw-face region and headache, respectively. Part of the clinical examination entailed palpation of the jaw, neck, shoulder, arm, thumb and calf muscles. Logistic regression was applied with pain and headache as dependent variables. A p-value $< .05$ determined statistical significance.

Results: Five percent of participants reported frequent pain in jaw-face, and 17% reported frequent headaches. In the regression analysis, frequent headaches were significantly associated with jaw muscle PtP (OR 2.1, CI 1.4–3.4), regional PtP (OR 4.5, CI 2.6–7.6), and generalized PtP (OR 6.1, CI 2.2–17.0). Jaw-face pain was significantly associated with regional PtP (OR 5.3, CI 2.2–13.0) and generalized PtP (OR 30.1, CI 9.3–97.0). The relationship between pain prevalence and PtP showed a dose-response pattern.

Conclusions: The study indicates that frequent jaw-face pain and headache are primarily associated with signs of regional and widespread hyperalgesia, which may be linked to the central sensitization mechanism. Signs of widespread hyperalgesia should be accounted for in the diagnostic algorithms when examining patients with pain in the jaw, face, and head regions.

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Introduction

Pain is defined by the International Association for the study of Pain (IASP) as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage' [1]. Chronic pain is considered when the duration exceeds 3 months [1], and hence, exceeds the acute warning function of physiological nociception [2]. The prevalence of chronic pain has been recognized at ~20% worldwide [3], and it is often associated with sleep disorders, mood disturbance [4], and low quality of life [5]. It has been estimated that 52% of patients with chronic pain have comorbid depressive symptoms [6] that result in low work function (e.g. sick leave) and high health care utilization [7].

Pain in the craniofacial region often termed orofacial pain, is a common condition and for many is a disabling condition [8]. The prevalence of orofacial pain varies considerably between studies (1.3–48%) depending on the questionnaire's wordings; however, approximately 20–25% may report chronic orofacial pain (more than 3 months) in surveys [5]. In a large population-based survey from the United Kingdom, a low prevalence of facial pain was observed with approximately 2% reporting the presence of facial pain within the last month that also interfered with usual activities [9]. In the introduction of a recently presented international classification of Orofacial pain, the editors point out that there is no comprehensive, internationally accepted classification of orofacial pain, which results in too many cases of misdiagnosis and misdirected treatment efforts [10].

Temporomandibular disorders (TMDs) is a term that refers to a number of painful and non-painful disorders that affect the muscles of mastication, the temporomandibular joint (TMJ) and contiguous structures [10]. TMDs are considered as the most prevalent chronic pain condition in the orofacial region [11]. Similar to many other musculoskeletal pain conditions and headaches [1,12], the prevalence of TMDs is higher in women than men with a gender ratio of approximately 2:1 [13–15].

Diagnosis and aetiological views of orofacial pain, as well as TMD pain, are debatable since these are predominantly classified on anatomical location, signs and symptoms rather than on the understanding of the underlying pathophysiological mechanisms of the persisting pain [12]. Moreover, the multifactorial aetiology for TMD [16], as well as the presence of several comorbid conditions [17,18] renders the decision-making process in relation to diagnosis even more complex

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[12]. Although different potential causes that include biological, chemical, physical, occupational, psychological factors and genetic predisposition have been suggested by previous research, no necessary or sufficient cause has been identified [19,20]. The work by Schwartz, one of the pioneers in this field, showed that pain in TMD can develop to regions not innervated by the fifth cranial nerve such as trapezius, posterior cervical, neck, and shoulder regions [21]. In another study, more than 50% of the patients who were referred to the facial pain clinic, had widespread pain outside the trigeminal and cervical regions [22]. Patients with a combination of TMD and chronic neck pain reported more pain sites and showed widespread hyperalgesia compared to subjects with only chronic neck pain [23]. Already in a 35-year old epidemiological study, pain in the orofacial region, jaw muscle tiredness and headaches were all significantly associated with muscle pain sites to palpation outside the area innervated by the trigeminal nerve [24]. Therefore, TMD may be viewed as a condition involving the joints, the muscles, and the peripheral and central nervous systems. Understanding the pathophysiological and behaviour mechanism underlying a disorder is important for both a correct diagnosis as well as for proper treatment options [12].

The aim of this study was to analyze the relationship between different sites of elicited pain to muscle palpation, and reported frequent jaw-face pain and frequent headache, respectively.

Materials and methods

The study population included 35, 50, 65, and 75-year-old subjects residing in the county of Västerbotten, Sweden, which totals 11,324 individuals. The study population was stratified based on where the subjects lived, that is, inland or coastal regions. Random selection was applied to include 150 individuals in each age group and for each region (in total 1200 individuals). The study included both a questionnaire and a clinical examination. The questionnaire was sent, along with a return envelope, to an individual's home address. A filled-in questionnaire was returned by 987 individuals (response rate 82%), and 779 (response rate 65%) participated in a clinical examination.

Questionnaire

The questionnaire included 65 questions that focussed on socio-demographic characteristics, self-perceived general health and oral health, tobacco use, medication, dental care habits, symptoms in the jaw-face region and headache. The six questions in the questionnaire related to symptoms in the jaw-face region inquired about the presence of the following symptoms during the past 3 months: TMJ clicking sound; jaw-facial pain; jaw tiredness/stiffness; difficulties in opening wide; locking of the jaw; and headache. The frequency scale was as follows: No; Yes, occasionally; Yes, once or twice every week; Yes, several times a week; or Yes, daily. A reported occurrence once a week or more often was defined as 'frequent symptoms'. The responses in the analysis were dichotomized into frequent symptoms and those remaining.

Clinical examination

The clinical examinations were performed by four dentists and four chair-side assistants at public dental clinics close to the living address of the participants. Before the study started, the examiners were trained and their examination techniques were calibrated for all of the clinical variables. The calibration was done in relation to a golden standard. Two calibrations on voluntary subjects were needed before the accepted level for inter-examiner reliability (Kappa value 0.64–0.84) was achieved. The examinations included registration of dental status, occlusal supporting zones (Eichner index), periodontal pocket depth, soft tissue examination, the function of temporomandibular joint, maximal jaw opening capacity, presence of pain to palpation, and decision on treatment need. Details of the clinical examination have been presented in a previous paper [25].

The pain to palpation of specified muscle sites was registered when the palpation during two seconds elicited a palpebral reflex in the eyes or a protection/withdrawal reflex. One of the authors (AW) was the instructor, and in his opinion, the pressure applied was close to that currently advocated of ~1 kg; however, no Palpometer was available.

The following muscle or/and tendon attachment sites were palpated:

Extra oral sites

Temporal muscle; with the index, middle and ring fingers over the temple to palpate the anterior part, and posterior part extra orally.

Medial pterygoid muscles; subjects were asked to tilt the head slightly towards the palpated site, and the inner surface of the mandible angle was palpated with the index finger.

Deep masseter muscle; with the index finger in the area located between the backside of the ramus and the back border of the superficial masseter 2 cm below the tragus.

Intra oral sites

The origin of the masseter muscle was palpated bi-digitally with the index finger from the inside, and the thumb from the outside below the zygomatic arch.

The tendon of the temporal muscles; subjects were asked to open the jaw. The region of the insertion of the temporal muscle was palpated on the upper part of the inside of the coronoid process with the index finger.

Lateral pterygoid area; subjects were asked to move the jaw towards one side to palpate behind the buccal area of the third molar region with the tip of the little finger in a medial direction behind the maxillary tuberosity.

Body sites

The centre part of the sternocleidomastoid muscles, the trapezius muscles, the underside muscles of the forearm, thumb muscles, and calf muscles were palpated bi-digitally.

The location of the elicited pain to muscle palpation was grouped into the following 5 groups: those who had no registered pain to palpation (reference group); pain at jaw muscle sites only; pain at neck/shoulder muscle sites only; pain at both jaw and neck muscle sites (regional pain); and generalized pain to palpation (pain at neck/shoulders and arm, and hand, and calf muscles sites).

Statistical method

The data analysis was done with STATA statistical software version 10. The analysis was based on 779 individuals who participated in the clinical examination. Due to minor variations in missing data the included numbers of individuals in the regression analysis varied. The operational definition of dependent and independent variables is presented in Table 1. In the regression analysis, jaw-face pain once a week or more during the past 3-month period and headache once a week or more during the past 3-months period were used as dependent variables. The results are presented as odds ratios (OR) with a 95% confidence interval (CI). A *p*-value of less than .05 was considered statistically significant.

Results

For the 779 participants included in the analyses, the prevalence of frequent jaw-face pain during the past 3-month period was 5% ($n = 38$), and for frequent headache was 17% ($n = 127$). The majority did not react to muscle palpation (52%), still, 29% ($n = 224$) showed pain to palpation only in the jaw muscles sites, 5% ($n = 35$) in only the neck/shoulder muscles sites, 12% ($n = 95$) had regional PtP in jaw and neck muscle sites, and 2% ($n = 18$) had generalized PtP at all palpated sites (Table 1).

The relationship between symptoms and PtP showed a dose-response pattern (Table 2). With frequent headache used as the dependent variable, there was a significant relationship to local jaw muscle PtP (OR 2.1, CI 1.3–3.4), regional PtP (OR 4.5, CI 2.6–7.6) and generalized PtP (OR 6.1, CI 2.2–16.9) With frequent jaw-face pain used as the dependent variable there was a significant relationship to regional PtP (OR 5.3, CI 2.2–13.0) and generalized PtP (OR 30.1, CI 9.3–97.0) but not to local jaw muscle PtP (OR 1.9, CI 0.8–4.5).

Discussion

The present study indicates that frequent jaw-face pain and headache are primarily associated with signs of regional and widespread hyperalgesia which may be linked to the central sensitization mechanism. The odds of reporting craniofacial pain increased in a dose-response like pattern with the spread of pain response to manual palpation. The novelty of the result is that it seriously questions the presence of pain to palpation over the jaw-face muscles as a significant sign of local muscle injury.

The dependent variables in our study had a prevalence in line with what has previously been reported in epidemiological studies on adults [11,15,26]. The prevalence of sites eliciting pain to manual palpation was remarkably similar to that in a previous study among 35-year olds [24]. In both the previous and present studies, approximately half of the study population did not report pain at the palpated sites. The most common elicited pain locations were within the trigeminal innervation area and in both trigeminal and cervical innervated areas [27]. Based on previous research, the prevalence of fibromyalgia in the population, as a cluster of

Table 2. Association between prevalence of frequent headache, jaw-face pain, and headache and/or jaw-face pain, respectively, to different patterns of muscle pain to palpation (PtP) in an adult population.

	OR (CI)	*p*-Value
Frequent headache (17%)		
No PtP (control)	1.0	
Local neck/shoulder PtP	1.6 (0.6–4.3)	NS
Local jaw PtP	2.1 (1.3–3.4)	.001
Regional PtP	4.5 (2.6–7.6)	<.001
Generalized PtP	6.1 (2.2–16.9)	<.001
Frequent jaws-face pain (5%)		
No PtP (control)	1.0	
Local neck/shoulder PtP	nc	
Local jaw PtP	1.9 (0.8–4.5)	NS
Regional PtP	5.3 (2.2–13.0)	<.001
Generalized PtP	30.1 (9.3–97.0)	<.001
Frequent headache and/or jaws-face pain (19%)		
No PtP (control)	1.0	
Local neck/shoulder PtP	1.4 (0.5.3.7)	
Local jaw PtP	2.3 (1.5–3.5)	<.001
Regional PtP	4.9 (2.9–8.2)	<.001
Generalized PtP	9.8 (3.5–27.5)	<.001

Percentage values represent the proportion of subjects out of the 779 included in the clinical examination.
CI: 95% confidence interval; OR: odds ratio; nc: not computable; NS: non-significant.

Table 1. Description of dependent and independent variables ($n = 779$).

Definition		*n* (%)
Dependent variables		
Frequent headaches	Reported headaches once a week or more	127 (17)
Frequent jaw-face pain	Reported pain in the jaw-face area once a week or more	38 (5)
Independent variables		
No pain to palpation (PtP) (Reference)	No registered pain to palpation (PtP)	402 (52)
Local jaw PtP	PtP in jaw muscle sites only	224 (29)
Local neck/shoulder PtP	PtP in neck muscle sites only	35 (5)
Regional PtP	PtP in both jaw and neck muscle sites	95 (12)
Generalized PtP	PtP in all palpated regions of neck, arm, hand, and calf muscles	18 (2)

patients with generalized pain and hyperalgesia, is 1.75% [28]. In the present study, the individuals who presented with a widespread pattern of hyperalgesia (2%) may thus have related conditions, although this was not specifically verified.

Myofascial pain syndrome (MPS) is considered the most common pain condition involving the muscle and its connective tissues (i.e. fascia) [29]. MPS is characterized by the presence of trigger points [30] and is associated with other pain conditions such as craniomandibular dysfunction, tension-type headache, migraine, joint dysfunction, back, neck and shoulder pain [31,32]. The concept of myofascial trigger points is still instrumental in defining diagnosis and treatment targeted for many pain conditions [33], including the recently launched diagnostic criteria of TMD [34]. Despite the ambition to distinguish between joint pain and muscle pain, a substantial overlap between TMJ arthralgia and masticatory muscle myalgia has been reported [35].

The results of the present study show that tender/trigger points to palpation are commonly found in trigeminal and upper cervical innervated areas. These areas are closely integrated in sensorimotor functions that include the convergence of afferent signals to the brainstem and in nociceptive transmission [36]. One example of convergence between trigeminal nerves and cervical nerves in the brainstem is found in Whiplash injuries [37]. Those with chronic symptoms of such an injury with trigger points in the cervical area may experience referred pain in the trigeminal region [38]. In fact, intermittent pain induces changes at different levels in the nervous system that in turn lead to abnormal function and structural changes in the CNS [39,40]. Expansion of the receptive field of pain, secondary hyperalgesia, co-contraction or autonomic responses can be manifestations of such changes [33]. Central sensitization also results in more trigger points, which in turn might create widespread pain [32]. Therefore, the experience of pain is not only necessarily related to the state of the body tissue but is also a complex interplay between sensory, affective and cognitive features [41,42]. In the case of misinterpreting the source of pain, there is a risk that local pain conditions develop to more complex muscle pain disorders.

In the present study, different types of headache were considered as a single group of headache due to the questionnaire design. Frequent headache was significantly associated with all types of pain to palpation patterns except for local pain at neck/shoulder sites. Previous studies have reported a higher prevalence of TMD in headache patients and vice-versa due to a high degree of comorbidities among these disorders [43,44]. For example, in a patient-based study, 40% of the patients with tension-type headaches (TTH) also had myofascial TMD diagnosis [45]. In another study, patients with TTH experienced pain mostly at the masseter muscle, pericranial and neck regions [46]. A study among healthy controls and cases with chronic TTH showed larger referred pain areas from trigger points in the upper trapezius muscle among cases [47]. Based on 'an updated pain model', referred pain from active trigger points in the posterior cervical, head and shoulder muscles can be partly assumed for TTH due to central sensitization [48]. Headache disorders were ranked as the sixth cause of years lived with disability among other causes worldwide based on the Global burden of disease study [26]. Reflecting on the overlap and probably shared pathophysiological mechanism between myofascial TMD and tension-type headache, differential diagnoses between TMD and headache disorders and consequently accurate treatment strategies should be considered [49].

Another condition associated with central sensitization is fibromyalgia which may mislead clinicians in the diagnosis of the primary source of the pain. Fibromyalgia is a chronic and widespread musculoskeletal pain that has been present 3 months or longer in the four quadrants of the body [50]. In the present study, elicited palpebral reflex to palpation of each of the four different functional and anatomic parts of the body (shoulder, arm, hand, and leg) was used to estimate of the generalized tenderness. The study was not intended to identify cases with fibromyalgia. Previous research has reported an overlap of similar types of complaints among patients with fibromyalgia and those with TMD [51,52]. The work by Plesh et al. revealed that 75% of patients with fibromyalgia had TMD, while 18% of cases with TMD met the diagnostic criteria for fibromyalgia syndrome [53]. In a study by John et al., widespread pain was highly associated with the risk of developing TMD pain among women [54]. In the present study, 18% of the study population with frequent orofacial pain showed a pattern of widespread pain to palpation. Although we found significant associations between jaw-face pain, headache, and the spread of pain to muscle palpation, the wide confidence interval of odds ratios should be considered, and thus the results should be interpreted with caution.

Strengths and limitations

A random sample was drawn from the general population to ensure the representativeness of the population under study. The response rate to the questionnaire was good (82%) and the number of participants attending the clinical examination was acceptable (65%).

Different types of headaches were considered as one single group, without any attempt to distinguish between a primary and secondary form of headache, nor was there any diagnostic aim for reported pain conditions. The prevalence of headache occurring once a week or more often was defined as frequent headache which is similar to that which has been reported in another population-based study [55]. The response to palpation was measured when it elicited a palpebral or protection reflex since reliability was improved [56]. Psychological features and environmental factors (attention, anxiety) that may influence the pain expression were not included in the study due to the design of the questionnaire and the clinical examination protocol. The palpation of the region of the lateral pterygoid muscle was included in the examination protocol even though there was a risk for 'false positive' responses. However, the palpated muscles and tendon sites were those commonly used at the time of the

study. In 2014, a Delphi based consensus document advocated to palpate primarily extra oral muscle sites and added the criterion of 'familiar pain' elicited during the palpation, with a pressure of 1.0 kg, in order to increase both sensitivity and specificity for the diagnostic decision-making process [34]. The aim of the present study was not to arrive in or test the predictive values for a specific diagnosis, but was to analyze if pain elicited at local palpation in the craniofacial region may be confounded by more generalized hyperalgesia; and if so, this should be taken into consideration in the diagnostic decision process along with other components of the diagnostic puzzle.

Conclusions

The study indicates that both headache and jaw-face pain are associated with signs of regional and widespread hyperalgesia that may be linked to central sensitization. Palpation of muscles outside regions of the masticatory system should thus be accounted for in the diagnostic algorithms when examining patients with orofacial pain. The results of the present study may imply that there is a need for modification of current clinical diagnostic criteria for local myalgia in the temporomandibular region.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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