

## Intraoral somatosensory abnormalities in patients with atypical odontalgia—a controlled multicenter quantitative sensory testing study

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Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

### ARTICLE INFO

#### Article history:

Received 28 January 2013

Received in revised form 15 March 2013

Accepted 1 April 2013

#### Keywords:

Atypical odontalgia

Neuropathic pain

Orofacial pain

Quantitative sensory testing

Somatosensory sensitivity

### ABSTRACT

Intraoral somatosensory sensitivity in patients with atypical odontalgia (AO) has not been investigated systematically according to the most recent guidelines. The aims of this study were to examine intraoral somatosensory disturbances in AO patients using healthy subjects as reference, and to evaluate the percent agreement between intraoral quantitative sensory testing (QST) and qualitative sensory testing (QualST). Forty-seven AO patients and 69 healthy control subjects were included at Universities of Washington, Malmö, and Aarhus. In AO patients, intraoral somatosensory testing was performed on the painful site, the corresponding contralateral site, and at thenar. In healthy subjects, intraoral somatosensory testing was performed bilaterally on the upper premolar gingiva and at thenar. Thirteen QST and 3 QualST parameters were evaluated at each site, z-scores were computed for AO patients based on the healthy reference material, and LossGain scores were created. Compared with control subjects, 87.3% of AO patients had QST abnormalities. The most frequent somatosensory abnormalities in AO patients were somatosensory gain with regard to painful mechanical and cold stimuli and somatosensory loss with regard to cold detection and mechanical detection. The most frequent LossGain code was LOG2 (no somatosensory loss with gain of mechanical somatosensory function) (31.9% of AO patients). Percent agreement between corresponding QST and QualST measures of thermal and mechanical sensitivity ranged between 55.6% and 70.4% in AO patients and between 71.1% and 92.1% in control subjects. In conclusion, intraoral somatosensory abnormalities were commonly detected in AO patients, and agreement between quantitative and qualitative sensory testing was good to excellent.

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## 1. Introduction

Atypical odontalgia (AO) is an enigmatic chronic orofacial pain condition with no objective signs of pathology [2,4,13,14,18,25,26]. AO has also been termed phantom tooth pain [17], persistent dentoalveolar pain (PDAP) [19], peripheral painful traumatic trigeminal neuropathy [8], and persistent idiopathic orofacial pain (PIOP) [1]. It is generally agreed that AO is not a suitable term because it reveals nothing about the pain mechanisms. The most prevailing hypothesis about AO pain mechanisms is that it is a

neuropathic pain condition [2,13,18,27]. However, it is difficult to perform confirmatory tests of nerve pathology or damage intraorally. According to recent guidelines, both demonstration of somatosensory abnormalities and other confirmatory tests, such as electrophysiological tests or special neuroimaging techniques, are required for a definite diagnosis of neuropathic pain [8,24]. The level of certainty of the pain being neuropathic is only possible or probable without such confirmatory tests.

Somatosensory sensitivity can be measured with quantitative sensory testing (QST) [10–12,16,20–24]. Fortunately, recent years have provided much progress with regard to standardization of QST, starting with the formation of the German Research Network on Neuropathic Pain (DFNS) and the publication of a standardized QST protocol for examination and data analysis [16,21]. The German Network introduced the somatosensory profiles and LossGain

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scores based on z-scores computed using the means and standard deviations of a healthy reference material [12,16]. Basically, the LossGain scores allow condensation of somatosensory findings for all 13 QST parameters into one single score [12,16]. Recently, adaptations to this protocol for intraoral use were published and evaluated with regard to reliability in healthy subjects [20], and guidelines for intraoral somatosensory examination were published by a task force group formed by the Special Interest Group for Orofacial Pain under the International Association for the Study of Pain [22]. In earlier studies not using the standardized German protocol, we and others have shown somatosensory disturbances in the majority of AO cases [5,14,27]. However, no common pattern of somatosensory disturbances could be detected, which is in accordance with what the German Network found in, for example, postherpetic neuralgia and other neuropathic pain conditions [16]. So far, no studies have assessed intraoral somatosensory sensitivity in AO patients using the full standardized 13-parameter QST protocol.

Recently, we have also published results on reliability of simple chairside qualitative somatosensory testing (QualST) and comparison of these simple tests between AO patients and healthy control subjects [7]. QualST has been used for many years in clinical settings and may serve as an initial screening of patients with persistent orofacial pain. However, to the best of our knowledge, no studies have investigated the agreement between standardized QST and QualST for any test site.

The aims of this multicenter study were to examine intraoral somatosensory disturbances in AO patients using a healthy age- and gender-matched control group as reference material according to the most recent standardized protocol for intraoral QST, and to evaluate the level of agreement between intraoral QST and QualST in AO patients as well as healthy control subjects.

## 2. Methods

This investigation was a multicenter study involving the Universities of Washington (USA), Malmö (Sweden), and Aarhus (Denmark). The study was performed in accordance with the Helsinki Declaration, and written informed consent was obtained from all participants. The study protocol was approved by the ethics committees of all participating centers. The hypotheses of this study were that AO patients show somatosensory abnormalities in comparison with a healthy age- and gender-matched reference material, and that percent agreement between corresponding QST and QualST measures of thermal and/or mechanical sensitivity is fair.

### 2.1. Participants

Forty-seven patients with AO (40 women, 7 men, mean age  $55.2 \pm 2.0$  years) were included at Malmö University (Sweden), University of Washington (USA), and Aarhus University (Denmark). Sixty-nine age- and sex-matched healthy adult (>18 years) control subjects (53 women, 16 men, mean age  $51.8 \pm 1.3$  years) were included as a reference group. The healthy subjects were recruited through advertisements at the universities and in Aarhus also through the webpage <http://www.forsogsperson.dk>. Inclusion criteria for AO patients were: >18 years old, pain for more than 6 months in a tooth, or persistent pain after tooth extraction with no signs of pathology in clinical or radiographic examinations [2,3,6,13,14,18,25]. The AO pain should be nonparoxysmal and present during most of the day [25]. Exclusion criteria for AO patients were presence of other known orofacial pain conditions, such as odontogenic pain, trigeminal neuralgia, cluster headache, etc. Patients with temporomandibular disorders (TMD) were not excluded as long as the patient could clearly distinguish between

the 2 pain conditions [7] and the AO pain was not influenced by palpation of masticatory muscles or the temporomandibular joints or by movement of the jaws. The reason that AO patients with comorbid TMD were not excluded was that a large proportion of AO patients do in fact fulfill the Research Diagnostic Criteria for TMD [4]; therefore we chose the approach described in order to be able to analyze a representative sample of a sufficient size. The examiners including patients in the study were all experienced, trained orofacial pain clinicians and researchers. All included patients had been through a thorough clinical intraoral and extraoral examination with intraoral radiographs. In case of unclear diagnosis from standard intraoral radiographs, other imaging techniques were used (cone-beam computed tomography and/or magnetic resonance imaging). Exclusion criteria for the healthy subjects were orofacial pain or serious dental, medical, psychiatric, or personality disorders [7]. Slight to moderate levels of depression were allowed because such psychological comorbidity is very common among AO patients [4].

The AO subjects included in the study were characterized according to present pain intensity on a numerical rating scale of 0 to 10, duration of the AO pain in months, depression, and unspecific physical symptoms scores from the SCL-90 taken from the Axis II questionnaire of the Research Diagnostic Criteria for Temporomandibular Disorders [9].

### 2.2. Intraoral quantitative sensory testing

All investigators were carefully instructed and trained for at least 1 day with regard to performance of intraoral QST according to the latest guidelines [20–22], and practiced in healthy subjects [16]. In AO patients, intraoral QST was performed on the painful (or most painful) intraoral buccal gingival site, the corresponding contralateral “mirror-image” site, and as an extratrigeminal control, at thenar on the right hand. Importantly, the painful site and thereby the test site of the AO patients could be situated both in the upper and lower jaw and at the level of incisors, premolars, or molars. The QST data from the contralateral mirror-image site was used to compute the side-to-side difference for evaluation of so-called relative sensory abnormalities (please refer to section 2.4.2. for further information). In healthy subjects, intraoral QST was performed bilaterally on the attached gingiva buccal to the first premolar and in 33 healthy subjects also at thenar of the right hand. The full QST examination was performed 3 times, twice on the first day and once more on a separate occasion 1 to 2 weeks after the first session. Intraexaminer and interexaminer reliability was tested and will be reported in a separate article. The mean value from each subject for each QST variable from these 3 examinations was used for the present analyses.

The standardized assessment of small and large fiber function involved 13 thermal and mechanical tests [16,20–22]: cold detection threshold (CDT), warmth detection threshold (WDT), thermal sensory limen (TSL), paradoxical heat sensation (PHS), cold pain threshold (CPT), heat pain threshold (HPT), mechanical detection threshold (MDT), mechanical pain threshold (MPT), mechanical pain sensitivity (MPS), dynamic mechanical allodynia (DMA), windup ratio (WUR), vibration detection threshold (VDT), and pressure pain threshold (PPT). For all parameters, loss of somatosensory function as well as gain of somatosensory function was assessed [16]. Due to the current lack of multicenter reference data for all intraoral regions, we included an age- and sex-matched reference group tested in the upper premolar region (please see earlier description). Intraoral somatosensory sensitivity may vary slightly between different intraoral locations (upper jaw, lower jaw, incisor region, premolar region, molar region). However, as the DFNS has used hand data as representative for upper body and foot data for the lower body with a few exceptions, the buccal

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