

Original articles

Evaluation of skin sensitivity in individuals presented with temporomandibular disorder

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ABSTRACT

Purpose: to identify the occurrence of a difference in skin sensitivity between analogous points on the face in individuals with temporomandibular disorder.

Methods: a total of 60 individuals of both genders, aged 18 to 73 years, participated in the study. People classified with TMD signs and symptoms with the Fonseca Anamnestic Questionnaire were included. The skin sensitivity was evaluated with a Semmes-Weinstein esthesiometer. Sensitivity change was defined in this study as the occurrence of a difference between analogous points on both hemifaces. The localization of the points followed the regional block anatomical description and was confirmed with a neuromuscular electrostimulation device. The collected data were analyzed statistically with a 5% significance level.

Results: the occurrence of a difference in sensitivity between the analogous points had a significant association with age group and severity of TMD. However, no association was perceived between sensitivity change and gender.

Conclusion: in the population studied, the more severe the temporomandibular disorder, the greater the skin sensitivity change on the face. Also, the older the person, the higher the number of analogous points with a difference in sensitivity.

Keywords: Face; Sensory Thresholds; Perception; Facial Pain

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INTRODUCTION

The stomatognathic system (SS) is richly characterized by proprioceptors that make it particularly sensitive and capable of efficiently controlling the motor function of the system. The stomatognathic proprioceptive mechanisms are decisive factors in the control of the stomatognathic function, driving the central nervous system to reach a functioning level adequate to the physiological purpose¹.

Sensitivity is the conscious interpretation of environmental sensory stimuli. Losing it or having it changed can cause important functional loss. In this regard, measuring it is extremely important².

The main sensitivity points ramify into objective surface sensitivity (involving tactile, pain, and thermal sensitivity) and objective deep sensitivity (encompassing vibratory, paresthetic, nerve trunk, visceral, segmental, active and passive movements, resistance, weight, and strength sensitivity)³.

Surface sensitivity (exteroceptive) provides information on the external stimuli of the skin receptors. Threshold tests establish the minimum stimulus value that can be perceived by the person, associated with the four classic skin functions: pain, heat, cold, soft touch/deep pressure².

Knowing how the nociceptive impulses are produced and how they are processed by the central nervous system is of great importance to understand the functioning of the stomatognathic system in patients with temporomandibular disorders (TMD) and chronic orofacial pain. Although such pathology has already been widely studied, the definition of its etiology and mechanism is still controversial, given the current possibilities of treatment⁴.

TMD encompasses a series of changes, either painful or not, in the region of the temporomandibular joint (TMJ), masticatory musculature, or both structures. The pains resulting from this pathology – usually located in the region of the temporal muscle or in the joint itself – can produce, besides limited articulatory movements and impaired orofacial function performance⁵, complaints related to anxiety and headache⁶. It is an either acute or chronic affection of multifactorial origin. When the pain becomes chronic, it is often associated with emotional, mood, and depression disorders, and central mechanisms that maintain the pain, such as the neuroplasticity process that changes the function of the central neurons either temporarily or permanently^{7,8}. These changes are responsible for

making the pain chronic, for transforming an acute pain in a chronic and persistent one⁹.

TMD-related chronic pain is considered the third most prevalent chronic pain condition. It can sharply impair these patients' quality of life¹⁰, lingering even after the lesion was remitted, due to central sensitization. It is usually nonresponsive to traditional therapy and requires multidisciplinary treatment^{11,12}.

Various stimuli are necessary to evaluate the integrity of the afferent fibers, to understand the mechanisms involved in different painful conditions affecting the orofacial region. In this sense, quantitative sensory tests can be useful as instruments to identify these neural processes, as they enable somatosensory changes to be verified in pathological conditions with chronic pain. The type of afferent impulse, responsible for transmitting tactile, thermal, and pain stimuli, is related to a type of fiber. The tactile mechanical stimulus (to be tested in this study) is an excitation transmitted by rapid A-beta fibers, whose threshold can be effectively tested with monofilaments⁹.

By the end of the 19th century, Von Frey developed an instrument made of horsehair, focused on studying normal physiology – at that time, only soft touch thresholds were measured. Semmes and Weinstein developed in 1962 a broad set of nylon monofilaments that replaced Von Frey's². Currently known as esthesiometer, this instrument has six colored nylon monofilaments, each color representing a sensitivity threshold. This set of filaments is available in the Semmes-Weinstein manufactured by Sorri®¹³.

Studies highlight the esthesiometer's contribution to the measurement of sensitivity thresholds in regions that have already undergone some type of surgical intervention¹⁴. Although this instrument was meant for plantar and palmar evaluation, its use in the orofacial region has already been described in speech-language-hearing studies. It has been used to evaluate patients before and after orthognathic surgery to investigate the involvement of lower and midfacial skin sensitivity changes in oral function performance¹⁵. Monofilaments have also been reported in its use to measure sensitivity in patients with different pathological conditions, including temporomandibular disorder¹⁶.

Therefore, conducting this research has been justified by the contributions brought by the knowledge of skin sensitivity thresholds in patients with TMD to the studies related to face proprioception and SS.

The investigation of peripheral repercussions of central sensitization, present in patients with chronic

pain, interests not only the field of Dentistry but also that of Speech-Language Therapy – whose intervention procedures in this group of patients are based on therapy methods that involve peripheral stimuli. Hence, understanding such a mechanism is an essential step to decision-making.

This investigation aimed to identify the occurrence of different skin sensitivity between analogous points of the face in people presented with temporomandibular disorder.

METHODS

This research was approved by the ethics committee of the *Universidade Federal de Pernambuco*, Brazil, under evaluation report no. 2.514.702.

This was an analytical, observational, cross-sectional study whose variables were gender, age group, and severity of pain. It was conducted in the facilities of the Dentistry and Speech-Language-Hearing programs of two public universities of Pernambuco, Brazil. A total of 60 individuals of both genders, aged 18 to 73 years, participated in the study. They were patients attending an orofacial pain reference center, as well as professors, students, and employees from these institutions.

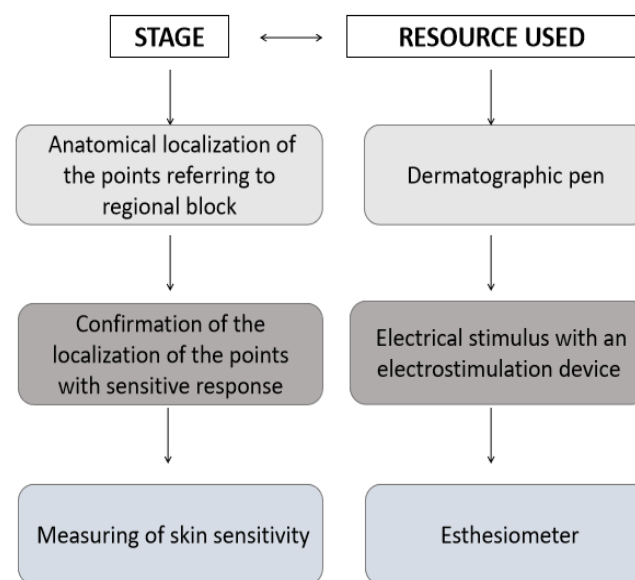
The people included in the study were those classified with signs and symptoms of TMD with the Fonseca Anamnestic Questionnaire (DMF)¹⁷, with or without complaint of orofacial pain. The exclusion criteria considered individuals who had been submitted to face surgeries and/or trauma; with a history of facial paralysis; with syndromes or changes related to the face structures; with a disability; with neurological or psychiatric problems that hindered communication; and people undergoing dental and/or speech-language-hearing treatment for TMD or orofacial pain at the time of the collection.

The participants were categorized as mild, moderate, or severe TMD, according to DMF, which is meant to evaluate the presence and classify the degree of severity of temporomandibular disorder¹⁷.

After the DMF was administered to the volunteers who initially complained of orofacial pain, they were asked about the beginning of the pain symptoms. It was then verified that all the participants with severe TMD reported having pain for over three months, which is considered chronic¹⁸. Nevertheless, this parameter was not analyzed in the present study.

Data were collected in individual evaluations. Initially, the participant answered a questionnaire for identification, which also had questions about facial

pain complaints. Then, the subjects were evaluated following the methodological steps shown in Figure 1.



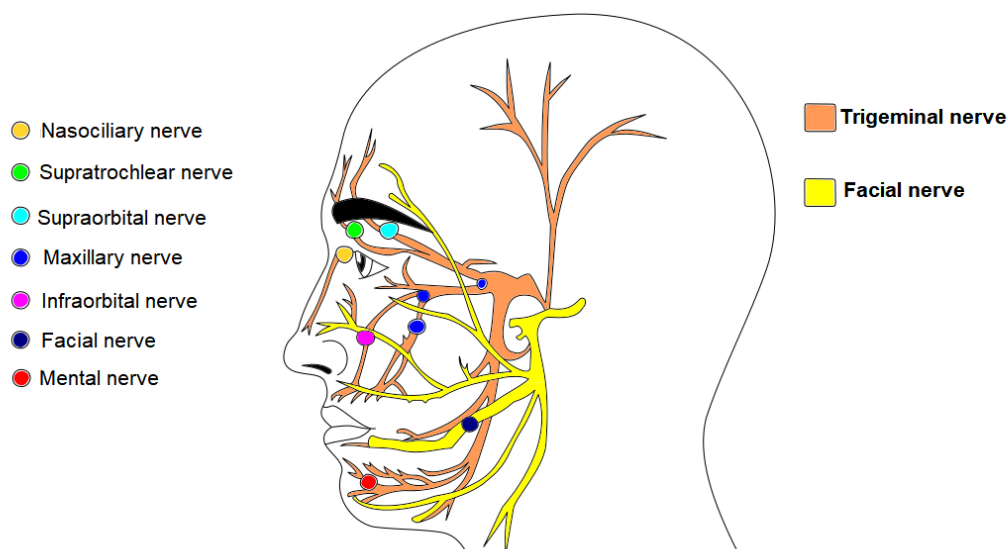
Source: The authors

Figure 1. Data collection flowchart

Figure 2 indicates the anatomical localization of the trigeminal and facial nerves regional block points, according to the *Atlas de Técnicas de Bloqueios Regionais da Sociedade Brasileira de Anestesiologia* (Atlases of Regional Anesthesia Techniques from the Brazilian Anesthesiology Society)¹⁹.

The points on the face were marked with a dermatographic pencil. To assure the right localization, the points were confirmed with a Neurodyn II – Ibramed neuromuscular electrostimulation device, used on the face with electrostimulation pens. The decision to use this complementary procedure was due to the anatomical variations from person to person, while the regions that were going to be tested with the esthesiometer needed to be precisely identified. Studies show variations in the ramifications of the trigeminal nerve²⁰ and facial nerve²¹; accordingly, the regional block points can be more medially or laterally located.

A low-frequency sensory current with minimum stimulation time and intensity was applied to pick up a response in that region. The volunteer was instructed to report a slight tingling or any other sensation. It should be highlighted that the stimulus applied was not enough to generate muscle contractions, neural accommodation, or muscular tetany. In the cases whose electrical confirmation did not coincide with the traditional anatomical markings, adjacent regions were tried until the participant reported a response to the stimulus.



Skin sensitivity points measured with the esthesiometer

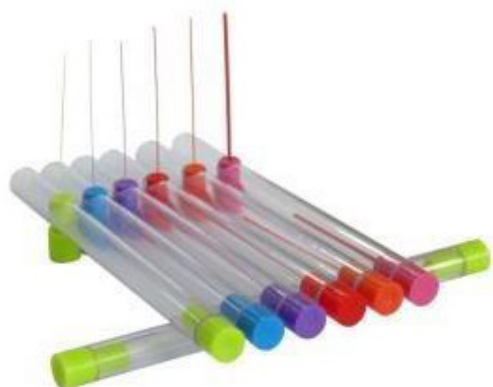
(According to the Atlases of Regional Anesthesia Techniques from the Brazilian Anesthesiology Society)

Source: The authors

Figure 2. Regional block points for the measurement of skin sensitivity

After confirming the points, the volunteers had their skin sensitivity threshold measured with the esthesiometer – the central objective of this study. The esthesiometry was performed after a 15-minute break to minimize potential interferences resulting from the stimulation used to confirm the points.

The esthesiometer has standardized monofilaments of various diameters and equal length, differentiated by their colors. Each color, with a distinct grammage, represents a sensitivity threshold²². This set of filaments is available in the Semmes-Weinstein manufactured by Sorri® (Figure 3).



Source: Public domain

Figure 3. Sorri® Semmes-Weinstein Esthesiometer

Before measuring, the researcher conducted the procedure on the back of the volunteer's hand for them to get familiar with the stimulus. Then, the participant was asked to remain seated with their head in the habitual position and eyes closed, to extinguish the visual cue.

To measure skin sensitivity, the filaments were perpendicularly positioned on the person's face and pressed against their skin until it buckled²² (Figure 4). The participant was asked to answer "yes" when they felt the touch, even if it were subtle.



Source: The authors

Figure 4. Use of the esthesiometer in an evaluation

The evaluation started with the lowest grammage filament (0.05 gf - green) and proceeded with filaments of increasing grammage until the highest one (300.0 gf - pink) (Figure 3), as instructed by the esthesiometer's manual. The first (green – 0.05 gf) and second filaments (blue – 0.2 gf), were tested three times. It was

considered conclusive to the stimulus if it obtained a positive response in at least one of the attempts. As for the other filaments, they were tested only once, also following the instrument's directions for use.

The responses were recorded in a collection protocol (Figure 5).

INSTRUMENT FOR THE EVALUATION OF SKIN SENSITIVITY WITH AN ESTHESIOMETER

Name: _____ No. : _____
 Date: ____/____/____



- Legend:
1. Supraorbital nerve
 2. Supratrochlear nerve
 3. Nasociliary nerve
 - 4, 5, 6. Maxillary nerve
 7. Infraorbital nerve
 8. Mental nerve
 9. Facial nerve

Check the boxes whose region/filament does not respond to the stimulus

| Region | Monofilaments | | | | | | | | | | | |
|--------|-----------------|---|---------------|---|-----------------|---|--------------|---|------------------|---|---------------|---|
| | Green (0.05 gf) | | Blue (0.2 gf) | | Violet (2.0 gf) | | Red (4.0 gf) | | Orange (10.0 gf) | | Pink (300 gf) | |
| | Hemiface | | Hemiface | | Hemiface | | Hemiface | | Hemiface | | Hemiface | |
| | R | L | R | L | R | L | R | L | R | L | R | L |
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | |

Figure 5. Response marking sheet and filament table

The difference in sensitivity was defined in this study as the absence of similar responses between analogous points on both sides of the face – i.e., there was a difference in sensitivity when at the same point on opposite sides the patient responded to filaments of different grammage.

Data analysis procedure

The data were expressed in percentage and absolute frequencies for the categorical variables, and statistical values (mean, standard deviation, and median) for age. To evaluate the association between two variables, the Pearson chi-square test was used – or, in the variables whose condition for using the chi-square was not verified, the Fisher exact test was used.

The margin of error used in the decisions of the statistical tests was 5%. The data were entered into an Excel spreadsheet, and the statistical calculation was done in the IBM SPSS software, version 23.

RESULTS

The participants' age ranged from 18 to 73 years, mean of 40.23 years, a standard deviation of 16.13 years, and median 40.00 years. Most (83.3%) of the participants were females. Regarding age group, the less prevalent (15.0%) were those 60 to 73 years

old, whereas the percentages of those 18 to 39 years old and 40 to 59 years old were 46.7% and 38.3%, respectively.

Of the 60 participants, the highest percentage (41.7%) was of people with severe DMF, followed by 35.0% with moderate DMF, and 23.3% with mild DMF. A difference between analogous points was recorded in 35.0% – of which, 28.3% had one to three points with a difference, while the other 6.7% had four to nine points with a difference.

The association between the presence or not of a difference between analogous points and each of the variables (age group and severity of the TMD) is shown in Table 1. The percentage with a difference between analogous points was higher among those 60 years old or more (77.8%), and it increased along with the severity of TMD: 7.1% among those classified with mild TMD, 33.3% with moderate TMD, and 52.0% with severe TMD.

The age group was the only variable with an association. The frequency of one to three different points occurred in five out of the nine subjects 60 years old or more, 30.4% in the 40-to-59 age group, and 17.9% in the 18-to-39 age group. The four to nine points of difference did not occur among those 40 to 59 years old, although it did take place in two people 60 years or more, and in 7.1% of those 18 to 39 years old (Table 2).

Table 1. Results of the evaluation of differences between analogous points, according to gender, age group, and severity of the temporomandibular disorder

| Variable | Difference between analogous points | | | | p-value |
|-----------------------------------|-------------------------------------|------|----|------|---------------------|
| | Yes | | No | | |
| | n | % | n | % | |
| Gender | | | | | $p^{(1)} = 0.729$ |
| Males | 4 | 40.0 | 6 | 60.0 | |
| Females | 17 | 34.0 | 33 | 66.0 | |
| Age group | | | | | $p^{(1)} = 0.013^*$ |
| 18 to 39 | 7 | 25.0 | 21 | 75.0 | |
| 40 to 59 | 7 | 30.4 | 16 | 69.6 | |
| 60 or more | 7 | 77.8 | 2 | 22.2 | |
| Temporomandibular disorder | | | | | $p^{(1)} = 0.019^*$ |
| Mild | 1 | 7.1 | 13 | 92.9 | |
| Moderate | 7 | 33.3 | 14 | 66.7 | |
| Severe | 13 | 52.0 | 12 | 48.0 | |

(*) Significant association at 5%

(1) Fisher's exact test

Table 2. Results of the evaluation of the number of different points, according to gender, age group, and severity of the temporomandibular disorder

| Variable | Number of different points | | | | | | p-value |
|-----------------------------------|----------------------------|------|-------------|------|-------------|------|---------------------|
| | None | | From 1 to 3 | | From 4 to 9 | | |
| | n | % | n | % | N | % | |
| Gender | | | | | | | $p^{(1)} = 0.861$ |
| Males | 6 | 60.0 | 3 | 30.0 | 1 | 10.0 | |
| Females | 33 | 66.0 | 14 | 28.0 | 3 | 6.0 | |
| Age group (years) | | | | | | | $p^{(1)} = 0.013^*$ |
| 18 to 39 | 21 | 75.0 | 5 | 17.9 | 2 | 7.1 | |
| 40 to 59 | 16 | 69.6 | 7 | 30.4 | - | - | |
| 60 or more | 2 | 22.2 | 5 | 55.6 | 2 | 22.2 | |
| Temporomandibular disorder | | | | | | | $p^{(1)} = 0.065$ |
| Mild | 13 | 92.9 | 1 | 7.1 | - | - | |
| Moderate | 14 | 66.7 | 6 | 28.6 | 1 | 4.8 | |
| Severe | 12 | 48.0 | 10 | 40.0 | 3 | 12.0 | |

(*) Significant association at 5%

(1) Fisher's exact test

DISCUSSION

When this investigation's sample characteristics are observed, the findings coincide with the profile of patients with facial chronic pain proposed in some studies that indicated a higher prevalence of pain in female patients^{23,24} over 30 years old²⁵. The mean age in this study was 40 years, nearing the findings of another investigation whose mean was approximately 38 years²⁶.

An epidemiologic study points to an association between females and TMD, justifying that osseous and psychosocial pathologies affect more women than men. It also indicates that the prevalence of temporomandibular disorder symptoms is higher in reproductive-age females due to estrogen, which regulates the growth and development of bones²⁷.

A previously cited study justifies the higher prevalence of women with TMD by the different physiological conditions between the genders, such as the greater ligament laxity (which hinders the stabilization of the TMJ) and hormonal issues (which make women more prone to suffering physical and psychological tensions)²⁵.

The increase in the percentage of difference in sensitivity between analogous points corresponding to increase in age was similar to that found in a study that used the same instrument (Semmes-Weinstein monofilaments) to evaluate skin sensitivity in other parts of the body²⁸. That investigation²⁸ and other studies^{29,30} report a decreased skin sensitivity in older adults. The

justification for this diminished response lies in the classic characteristics of human aging and changes in the nervous system, with loss of myelinated and unmyelinated fibers and slowed nervous conduction³¹.

In another study³² evaluating plantar sensitivity with this same instrument, the responses decreased in relation to the participants' age. The decrease in skin mechanoreceptors and neural excitability, inherent to aging, can determine a negative relationship between skin sensitivity and an increase in age. In the present paper, an association was likewise verified between the number of analogous points on the face with a difference in sensitivity and the increase in age.

The occurrence in this study of a higher percentage of individuals with differences in sensitivity between analogous points of the face can be justified by the fact that clinical changes, such as the increase in skin sensitivity and hyperalgesia, are observed in patients with general orofacial pains³³.

In yet another study³⁴ that evaluated plantar sensitivity, changed sensitivity was verified in subjects with fibromyalgia. The authors hypothesize that there was a pain processing hyperstimulation, modulated in the central nervous system, due to the nociceptive sensitivity variations in the skeletal muscle and, consequently, these patients' exacerbated responses. However, what happened was the decrease in response to the stimulus with the esthesiometer. In this regard, the presence of pain seems to somehow change the response to skin stimulus.

A study³⁵ relating headache and TMD to the increase in pericranial sensitivity justifies that the relationship takes place through a physiopathological mechanism of the trigeminal nerve, which is the one responsible for orofacial sensitivity. Nonetheless, it should be highlighted that the data presented in this investigation did not take complaints of headache into account, despite being a common symptom in patients with TMD.

No association was perceived between gender and difference in sensitivity in analogous points of the face. A piece of research on the sensitivity of lesioned hands of male and female soccer goalkeepers did not find changes – both the men and the women obtained normal values in the esthesiometry³⁶. It is suggested that an investigation be conducted to relate these two variables.

On the other hand, an evaluation of thermal perception in men and women showed that there are differences in the neural mechanisms in response to a thermal stimulus. It also pointed out that there are greater differences between the regions of the women's body than of men's, either for cold or heat³⁷. In the present study, no thermal stimuli were used; however, the skin receptors that respond to hot, cold, and soft touch/deep pressure stimuli are the same².

As previously stated, women are more prone to suffering from psychological tensions²⁵. When this issue is discussed, it is known that anxiety and depression can induce or aggravate TMD symptoms^{38,39}. Considering that sensitivity change³³ is a common symptom of this disorder, it can be suggested that women present this difference more often than men.

A minimum amount of studies approaching temporomandibular disorder and skin sensitivity was found. Hence, the present research is in want of a more detailed investigation.

Self-medication, which was not controlled in this study, can be a limitation. Having undergone dental treatment for TMD was among the exclusion criteria. However, taking anti-inflammatories, muscle relaxants, antidepressants, and other drugs commonly prescribed independently to patients with pain was not analyzed.

It is suggested that further studies be conducted, evaluating other variables involved in the perception of skin sensitivity thresholds in patients with temporomandibular disorder.

CONCLUSION

This investigation led to the conclusion that it is possible to find sensitivity changes in people with complaints of TMD, especially in the most severe cases.

In this sample, it was also observed that sensitivity was changed in adults over 60 years old with TMD. Moreover, an association was found between the age group and the number of analogous points of the face with a difference in sensitivity.

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