Clinical observation of patients with inferior alveolar nerve sensory disturbance

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Abstract: Fifty-four patients diagnosed with paresthesia on one side of the lower lip or skin in the chin area, were examined by multiple sensory tests and assessed self-reported subjective symptoms and the psychological state through questionnaires. Additionally, they were followed over time. Each sensory test threshold was evaluated and classified according to the individual way of scoring system, and the average sensory score (ASS) was used to analyze the correlation between self-reported symptoms and psychological state. On the second visit, all sensory test results had improved. The ASS was positively correlated with the pain questionnaire on the first visit; however, it did not correlate with psychological state or personality. There was a positive correlation between neuroticism and anxiety scores. The index of change (IC) of the ASS over time did not correlate with the IC of patients' self-reported symptoms or mental state. The IC of ASS data was not yet a valid and reliable treatment for sensory disturbances in the orofacial region. The present study was performed with the Helsinki Declaration.

Materials and Methods

Participants
This study was approved by the Ethical Committee of Tokyo Medical and Dental University (D2019-035) and was performed in accordance with the Helsinki Declaration.

Fifty-four patients (18 males, 36 females) with sensory disturbances who underwent two examination sessions between September 2005 and May 2016 at the Department of Maxillofacial Surgery, Tokyo Medical and Dental University were included. At the time of the first examination, all patients, aged 20-79 years (mean age 46.3 years), had clinical symptoms and complaints of paresthesia on the unilateral lower lip or chin area due to nerve injury. The first examination was between 4 days and 60 months (mean 4.9 months) following the patient’s awareness of apparent symptoms of paresthesia or nerve injury. The time interval between both examinations was from 1 to 20 months (mean 6.2 months).

The causes of sensory disturbances were identified as surgical procedures, such as tooth extraction, cystectomy, dental implant, and other procedures. Progressive diseases, such as bisphosphonate-related osteonecrosis of the jaw and some metastatic lesions, were excluded. Sensory disturbances were a result of mandibular tooth extraction in 24 patients (44.4%), following cystectomy with tooth extraction in nine (16.7%), dental implant treatment in seven (13.0%), surgical treatment of benign tumors in two (3.7%), other dental treatment in five (9.3%), and other conditions (e.g., inflammation, fracture of the mandible, etc.) in seven (13.0%). The ratio between male and female was 1:2, with 18 male and 36 female patients (Table 1).

Assessment of sensory disturbances
A clinician examined one patient at a time in a calm and noise-free room with consistent temperature and humidity. At the time of the examination, patients were instructed to close their eyes and sit with their back straight. The sensory thresholds of the corresponding points on the non-affected side were also examined. Differences between sides were determined, and the most significant numerical difference between sides was considered to reflect the level of disturbance. Examination sites were marked as 1, 2, 3, and 4, and additional examination sites were added based on symptoms (Fig. 1). To examine the sensory threshold, the following methods were applied: Semmes-Weinstein monofilament (SW) test (Sakai Medical, Tokyo, Japan), 5-Hz rectangular wave current stimulation (RCS) test (SEM4201; Nihon Kohden, Tokyo, Japan), two-point discrimination (TPD) threshold test (Mackinnon-Dellon Disk-Criminator; North Coast Medical Incorporated, Morgan Hill, CA, USA), thermal detection threshold tests of warmth (W), heat (H), cold (C) (Thermal stimulator; DiaMedical, Tokyo, Japan), and current perception threshold (CPT) tests (Neurometer; Neu-
performed on regions 1 and 3. Thermal stimulation (W, H, and C) were discriminated several times were set as a threshold value. TPD was confirmed whether Disk #1 could be determined as one point and #15 as Disk #1 (0 mm) as one point, it was considered indistinguishable. After points was set to Disk #15 (15 mm); if the patient could not determine 2, 3, and 4. In the TPD test, the upper limit of the distance between two points was set to 20°C; the lowest current value that patients detected was considered the threshold. The SW and RCS tests were performed randomly on regions 1, 2, and 3. The RCS used values from (JMPQ) (Table 2). The JMPQ consists of a list of 20 selected sensory expressions divided into four different subgroups (sensory, affective, evaluative, and miscellaneous). The patient’s self-reported responses were counted and given a numerical value based on the number of words chosen (NWC; 0-20) by the number of chosen categories. Also, the pain rating index (PRI) was calculated based on the selected word’s ranking value. In this scoring system, the word in each subgroup was given a value of 1; the next word, a value of 2, etc., and the values of the words chosen by a patient were then totaled to obtain a score for all categories (PRI total; 0-78) [16].

In addition, to further investigate the level of subjective sensory abnormality, three different self-reported visual analog scales were developed (VAS; 0-100): (1) “self-reported degree of hindrance in daily life” (HDL), severe being highly inconvenient; (2) “self-reported sensory feeling” (SF), severe being a strong abnormal feeling; and (3) “self-reported length of time worrying” (LT), severe being worried about abnormal feelings all the time (Fig. 2).

Assessment of personality and psychological state
The patient’s personality was analyzed using the Modified Japanese Version of the Short-Form Eysenck Personality Questionnaire (MS-EPQ), where a total of 12 items (six for neuroticism and six for extraversion) were evaluated. The scores were totaled and analyzed; the scores ranged from six to 24 points [17].

To investigate the patient’s mental state of anxiety and depression, the Japanese version of the Hospital Anxiety and Depression Scale (HADS) were used. A total of 14 items (seven for depression and seven for anxiety) were evaluated; a score of 0-7 indicated no condition present, 8-10 suggested a condition was probably present, and 11-21 indicated a definite presence of anxiety or depression [18].

Analysis method
In sensory thresholds on the healthy side and HADS scores, differences due to age and sex were examined using the Mann-Whitney U test.

Based on the absolute differences between threshold values on the healthy and affected sides, each sensory test value on the affected side was scored in five levels (0, 1, 2, 3, and 4) (Table 3). Each patient was given a sensory score depending on the severity of sensory deficit shown by sensory examinations on the first and second visits.

Average sensory score (ASS)
Each patient’s ASS was calculated as follows:

Table 1 Causes of neurosensory deficits and subject cases

| Number of patients (%) | Average age (min-max) | Male | Female |
|------------------------|-----------------------|------|--------|
| Tooth extraction       | 24(44.4)              | 40.7(20-64) | 5.19   |
| Cystectomy (with tooth extraction) | 9(16.7)   | 49.7(27-79) | 7.02   |
| Dental implant         | 7(13.0)               | 59.1(42-70) | 1.06   |
| Surgical treatment of benign tumor | 2(3.7)   | 44.5(21-68) | 1.01   |
| Dental treatment other than the above | 5(9.3)    | 41.4(34-66) | 0.05   |
| Other (inflammation, fracture of mandible, etc.) | 7(13.0)   | 52.6(34-74) | 4.03   |

Total: 54(100)
46.3(20-79) 18:36

min, minimum; max, maximum
A possible correlation between the ASS and self-reported subjective symptoms (JMPQ and VAS), the ASS and personality (MS-EPQ), and anxiety and depression (HADS) were examined using Spearman’s rank correlation coefficient.

For the CPTs and thermal stimuli, the sensory scores of hypersensitive (sensory gain) patients in the first and second visits were compared. The index of change over time (IC) between the first and second visit examination values was compared following this formula:

$$IC = \frac{1st \ visit \ value - 2nd \ visit \ value}{2nd \ visit \ value}$$

In the five-point scoring system, a possible correlation between the IC of the ASS, the self-reported subjective evaluations, and the psychological questionnaire responses were examined (Spearman’s rank correlation coefficient).

Furthermore, without the five-point scoring system, whether differences could be seen were examined, in the IC of self-reported subjective evaluations and the psychological questionnaire responses for cases in which there was only hyposensitivity (sensory loss) on two visits and cases where there was hyposensitivity on the first visit but hypersensitivity on the second visit.

Results

Normal side threshold or psychological state by sex and age
The participants were divided almost in half by the median of age, with a younger group and an older group, and investigated whether there was a difference in healthy side threshold depending on age and sex, using inspection site 3 (Fig.1). Furthermore, whether differences in the psychological state (on HADS) were a result of age and sex differences, were examined. Older males had significantly lower thresholds for CPTs 250 and 5 Hz than all females. Younger females had significantly lower thresholds for the RCS than all older patients. There were no differences due to age and sex for the SW, TPD, W, H, C, and CPT 2,000 Hz tests, and the HADS (Table 4).

Distribution of participants by examination-specific sensory scores
The distribution of participants by examination-specific sensory scores on

Table 2  Japanese Version of the McGill Pain Questionnaire (JMPQ)

| Sensory qualities | 1) Flickering | Quivering | Pulsing | Throbbing | Beating | Pounding |
|-------------------|--------------|-----------|---------|-----------|---------|---------|
| 2) Jumping        | Flashing     | Shooting  |         |           |         |         |
| 3) Pricking       | Boring       | Drilling  |         | Stabbing  | Lancing |         |
| 4) Sharp          | Cutting      | Lacerating|         |           |         |         |
| 5) Pinching       | Pressing     | Gaining   |         | Cramping  | Crushing|         |
| 6) Tugging        | Pulling      | Wrenching |         |           |         |         |
| 7) Hot            | Burning      | Scalding  |         | Searing   |         |         |
| 8) Tingling       | Itchy        | Smarting  |         | Stinging  |         |         |
| 9) Dull           | Sore         | Hurting   |         | Aching    | Heavy   |         |
| 10) Tender        | Taut         | Raspaging |         | Splintering|        |         |

Table 3  Scores categorized by laterality of sensory test thresholds

| Score | SW | TPD | Thermal stimulation | RCS (mA) | CPT (CPT) | HADS |
|-------|----|-----|----------------------|----------|-----------|------|
|       | W (°C) | H (°C) | C (°C) | 2,000 Hz | 250 Hz | 5 Hz |
| 0     | 0-2 | 0-2 | 0 | 0 | 0-20 | 0-10 | 0-3 |
| 1     | 3-5 | 3-5 | 1 | 1,2 | 0.1 | -50 | -20 | -10 |
| 2     | 6-9 | 6-8 | 2-4 | 3-5 | 2 | 0.2-0.3 | -80 | -50 | -30 |
| 3     | 10-19 | 9-12 | 5-18 | 6-10 | 3-18 | 0-0.9 | -220 | -170 | -130 |
| 4     | Undeterminable | Undeterminable | Undeterminable | Undeterminable | Undeterminable | Undeterminable | Undeterminable | Undeterminable | Undeterminable |

Table 4  Median of the thresholds on normal site 3 by age and sex (first visit)

| Age | Sex (N) | SW | TPD | Thermal stim (°C) | RCS (mA) | CPT (CPT) | HADS |
|-----|---------|----|-----|-------------------|----------|-----------|------|
|     |         | W | H   | C     | 2,000 Hz | 250 Hz | 5 Hz |
| -46 | Male (9) | 2 | 8 | 36 | 47.6 | 30 | 0.2 | 142 | 34 | 17.5 |
|     | Female (17) | 1 | 7 | 36 | 44.5 | 32 | 0.2 | 139 | 44 | 18 |
| 47- | Male (9) | 2 | 7 | 40 | 48 | 32 | 0.3 | 102 | 12.5 | 6.4 |
|     | Female (19) | 2 | 7 | 37 | 43 | 30.5 | 0.3 | 123 | 34.5 | 21.7 |

ASS = sum of all sensory scores (SW + TPD + W + H + C + RCS + CPT2,000 + CPT250 + CPT5) / number of tests

A possible correlation between the ASS and self-reported subjective symptoms (JMPQ and VAS), the ASS and personality (MS-EPQ), and anxiety and depression (HADS) were examined using Spearman’s rank correlation coefficient.

For the CPTs and thermal stimuli, the sensory scores of hypersensitive (sensory gain) patients in the first and second visits were compared. The index of change over time (IC) between the first and second visit examination values was compared following this formula:

IC=1st visit value-2nd visit value

In the five-point scoring system, a possible correlation between the IC of the ASS, the self-reported subjective evaluations, and the psychological questionnaire responses were examined (Spearman’s rank correlation coefficient).

Furthermore, without the five-point scoring system, whether differences could be seen were examined, in the IC of self-reported subjective evaluations and the psychological questionnaire responses for cases in which there was only hyposensitivity (sensory loss) on two visits and cases where there was hyposensitivity on the first visit but hypersensitivity on the second visit.

Results

Normal side threshold or psychological state by sex and age
The participants were divided almost in half by the median of age, with a younger group and an older group, and investigated whether there was a difference in healthy side threshold depending on age and sex, using inspection site 3 (Fig.1). Furthermore, whether differences in the psychological state (on HADS) were a result of age and sex differences, were examined. Older males had significantly lower thresholds for CPTs 250 and 5 Hz than all females. Younger females had significantly lower thresholds for the RCS than all older patients. There were no differences due to age and sex for the SW, TPD, W, H, C, and CPT 2,000 Hz tests, and the HADS (Table 4).
the first and second visits is shown in Table 5-1 and 5-2. According to applied sensory scoring system, the scores of all sensory tests improved on the second visit compared with the first visit. As every patient had some level of abnormal feeling, the most sensitive sensory test in the scoring system was H. It had the most patients (48, 98.0%) with a sensory score over 7 for some patients (Table 6). The ASS, the average of all sensory scores per patient, showed a positive correlation with the NWC (JMPQ) and PRI (JMPQ); however, it showed no correlation with the threeVAS scores, MS-EQP, and HADS). Almost all the self-reported subjective symptoms (JMPQ and VAS scores) were correlated with each other. The HADS anxiety score showed a positive correlation with the HADS depression score and the MS-EQP neuroticism score (Table 7).

IC of the ASS and self-reported values (JMPQ, VAS, MS-EQP, and HADS)

For the ASS, the median and minimum IC values were positive numbers, meaning that the patient’s second examination sensory scores (values) were lower than the first examination scores. In all self-reported values (JMPQ, VAS scores, and HADS), the minimum IC was negative, although the median IC was a positive number (Table 8). Furthermore, the IC of the ASS did not correlate with the IC of all self-reported values. There was some correlation between the IC of self-reported values, such as the

### Table 5-1 Distribution of participants by examination-specific sensory scores (%): first visit

| Sensory score | SW | TPD | Thermal stimuli | RCS | CPT |
|---------------|----|-----|-----------------|-----|-----|
| 0             | 17 (31.5) | 6 (11.5) | 3 (6.0) | 1 (2.0) | 5 (12.5) | 13 (24.1) | 7 (15.9) | 6 (12.8) | 5 (10.6) |
| 1             | 9 (16.7) | 7 (13.5) | 3 (6.0) | 5 (10.2) | 2 (5.0) | 6 (11.1) | 5 (11.4) | 8 (17.0) | 6 (12.8) |
| 2             | 10 (18.5) | 5 (9.6) | 6 (12.0) | 2 (4.1) | 4 (10.0) | 10 (18.5) | 2 (4.5) | 6 (12.8) | 10 (21.3) |
| 3             | 6 (11.1) | 1 (1.9) | 10 (20.0) | 7 (14.3) | 10 (25.0) | 9 (16.7) | 11 (25.0) | 17 (36.2) | 15 (31.9) |
| 4             | 12 (22.2) | 53 (63.5) | 28 (56.0) | 34 (69.4) | 19 (47.5) | 16 (29.6) | 19 (43.2) | 10 (21.3) | 11 (23.4) |

*SW, Semmes-Weinstein monofilaments; TPD, two-point discrimination; W, warmth; H, heat; C, cold; RCS, rectangular wave current stimuli; CPT, current perception threshold*

### Table 5-2 Distribution of participants by examination-specific sensory scores (%): second visit

| Sensory score | SW | TPD | Thermal stimuli | RCS | CPT |
|---------------|----|-----|-----------------|-----|-----|
| 0             | 33 (61.1) | 24 (46.2) | 10 (18.9) | 5 (11.4) | 15 (26.6) | 33 (61.1) | 33 (61.1) | 8 (16.7) | 6 (12.8) | 17 (37.0) |
| 1             | 8 (14.8) | 8 (15.4) | 14 (26.4) | 9 (20.5) | 12 (29.3) | 15 (27.8) | 8 (16.7) | 16 (34.0) | 9 (19.6) |
| 2             | 13 (24.1) | 6 (11.5) | 10 (18.9) | 13 (29.5) | 7 (17.1) | 4 (7.4) | 9 (18.8) | 6 (12.8) | 7 (15.2) |
| 3             | 0 (0) | 0 (0) | 14 (26.4) | 5 (11.4) | 7 (17.1) | 0 (0) | 12 (25.0) | 6 (12.8) | 7 (15.2) |
| 4             | 0 (0) | 14 (26.9) | 5 (9.4) | 12 (27.3) | 0 (0) | 2 (3.8) | 10 (20.4) | 1 (2.1) | 2 (4.3) |

### Table 6 Median of ASS and self-reported values (JMPQ, VAS, MS-EQP, and HADS)

| Sensory score | SW | TPD | Thermal stimuli | RCS | CPT |
|---------------|----|-----|-----------------|-----|-----|
| 0             | 33 (61.1) | 24 (46.2) | 10 (18.9) | 5 (11.4) | 15 (26.6) | 33 (61.1) | 33 (61.1) | 8 (16.7) | 6 (12.8) | 17 (37.0) |
| 1             | 8 (14.8) | 8 (15.4) | 14 (26.4) | 9 (20.5) | 12 (29.3) | 15 (27.8) | 8 (16.7) | 16 (34.0) | 9 (19.6) |
| 2             | 13 (24.1) | 6 (11.5) | 10 (18.9) | 13 (29.5) | 7 (17.1) | 4 (7.4) | 9 (18.8) | 6 (12.8) | 7 (15.2) |
| 3             | 0 (0) | 0 (0) | 14 (26.4) | 5 (11.4) | 7 (17.1) | 0 (0) | 12 (25.0) | 6 (12.8) | 7 (15.2) |
| 4             | 0 (0) | 14 (26.9) | 5 (9.4) | 12 (27.3) | 0 (0) | 2 (3.8) | 10 (20.4) | 1 (2.1) | 2 (4.3) |

### Table 7 Correlations of ASS and self-reported values (JMPQ, VAS, MS-EQP, and HADS) on first visit

| ASS | JMPQ | HDL | SF | LT | MS-EQP | HADS |
|-----|------|-----|----|----|--------|------|
|     | NWC  | PRI |    |    | Neuroticism | Extraversion | Anxiety | Depression |
| Median |     |     |    |    | 14 (41) | 15 (41) | 7 (41) | 4 (41) |
| First | 2.61 (54) | 5 (54) | 11 (54) | 52.5 (34) | 74.0 (34) | 95.0 (30) |     |     |
| Second | 1.17 (54) | 3 (54) | 9 (54) | 33.0 (38) | 46.0 (38) | 59.0 (31) | 14 (39) | 16 (54.0) | 6 (48) | 3.3 (40) |
| Min-max |     |     |    |    | 3-21 | 0-17 | 0-12 | 11-19 |
| First | 0.44-4.00 | 1-12 | 1-24 | 10.0-100 | 9.0-100 | 8.0-100 |     |     |
| Second | 0.38-3.00 | 0-16 | 0-44 | 0-100 | 0-100 | 0-100 | 24-74 | 10-23 | 0-15 | 0.9 |
| 25-75%ile |     |     |    |    |     |     | 11-16 | 14-19 | 2-8 | 2-5 |

**ASS, average sensory score (0-4); JMPQ, Japanese version of the McGill Pain Questionnaire; NWC, number of words chosen (0-20); PRI, pain rating index (0-78); HDL, self-reported degree of hindrance in daily life (0-100); SF, self-reported sensory feeling (0-100); LT, self-reported length of time worrying (0-100); MS-EQP, Modified Japanese Version of the Short-Form Eysenck Personality Questionnaire (6-24); HADS, Japanese version of the Hospital Anxiety and Depression Scale (0-21); min-max, minimum-maximum; ( ) indicates number of patients.**

Correlation of ASS and self-reported values (JMPQ, VAS, MS-EQP, and HADS)

The median values of ASS and self-reported subjective symptoms were reduced on the second visit compared to the first. In the first examination, there was no patient whose ASS was 0, but in the second examination, there was one patient whose ASS was 0. On both visits, there were several patients whose maximum values on the HDL, SF, and LT tests were the highest value (100). The median score on the HADS test was reduced on the second visit compared to the first; however, the maximum scores were over 7 for some patients (Table 6). The ASS, the average of all sensory scores per patient, showed a positive correlation with the NWC (JMPQ) and the PRI (JMPQ); however, it showed no correlation with the three VAS scores, MS-EQP, and HADS. Almost all the self-reported subjective symptoms (JMPQ and VAS scores) were correlated with each other. The HADS anxiety score showed a positive correlation with the HADS depression score and the MS-EQP neuroticism score (Table 7).
NWC (JMPQ) with the PRI (JMPQ), HDL (VAS), and SF (VAS); the PRI (JMPQ) with HDL (VAS) and SF (VAS); HDL (VAS) with SF (VAS); and the anxiety (HADS) score with the depression (HADS) score (Table 9).

The ratio of patients whose IC was positive was 100% on the ASS, 55.6% on the NWC (JMPQ), 66.7% on the PRI (JMPQ), 63.6% on HDL (VAS), 78.8% on SF (VAS), and 85.2% on the LT (VAS) (Table 8). They were examined whether the IC of self-reported values was positive based on sex and age (younger group under 47 years versus older group 47 years and over). Results showed that the IC of the HADS depression score was statistically positive for older females compared with younger males (P < 0.05: χ² test), and the IC of other self-reported values was not related to age or sex.

Cases of diagnosed hypersensitivity

Each sensory score represented the difference between the sensory threshold on the affected and healthy sides without sensory loss (hyposensitivity) or gain (hypersensitivity). On the first visit, the thresholds on the affected side were lower than those on the healthy side in 17 patients for CPTs (2,000, 250, 5 Hz) and in five patients for the thermal tests (W, H, and C), suggesting hypersensitivity. On the second visit, the thresholds in 26 patients for CPTs and in 22 patients for the thermal tests suggested hypersensitivity. These cases were not excluded from the pool of participants with hyposensitivity, and their data were analyzed similarly. The number of patients with hypersensitivity increased on the second visit compared to the first (Fig. 3).

Differences in changes of declaration items were examined to determine whether they could be seen when comparing cases in which only hyposensitivity was seen in both examinations, and only hyposensitivity on the first visit and hypersensitivity in the thermal tests or CPTs on the second visit (Table 10). Forty-six patients showed hyposensitivity in all examinations on the first visit; 26 of these showed hypersensitivity and 20 of these showed hypersensitivity in the thermal tests or CPTs on the second visit. Without considering the five-point scoring system, there was no significant difference in changes of self-reported subjective evaluations and psychological questionnaire responses as to whether hypersensitivity developed, although improvement of VASs tended to be greater in patients

### Table 8: Index of change over time (IC)

|                | ASS | JMPQ | PRI | HDL | SF | LT | HADS |
|----------------|-----|------|-----|-----|----|----|------|
| Median         | 1.1 | 1    | 2   | 20.0| 18 | 22 | 1    |
| 25-75%ile      | 0.57-1.97 | -0.25-3 | -2.525 | -5.485 | 2.5-38.0 | 2.0-54.0 | 0-2 |
| Min-max        | 0.12-3.0 | -8.10 | -26.25 | -47.89 | -51.71 | -55.100 | -4-9 |
| %total (%)     | 54/54 (100) | 30/54 (55.6) | 30/54 (66.7) | 21/33 (63.6) | 26/33 (78.8) | 23/27 (85.2) | 23/35 (65.7) |

ASS, average sensory score; JMPQ, Japanese version of the McGill Pain Questionnaire; NWC, number of words chosen; PRI, pain rating index; HDL, self-reported degree of hindrance in daily life; SF, self-reported sensory feeling; LT, self-reported length of time worrying; MS-EPQ, Modified Japanese Version of the Short-Form Eysenck Personality Questionnaire; HADS, Japanese version of the Hospital Anxiety and Depression Scale; min-max, minimum-maximum; %total, number of positive IC/total number examined

### Table 9: Correlation between the index of change over time of the ASS, JMPQ, VAS, and HADS

|                | ASS | JMPQ | PRI | HDL | SF | LT | HADS |
|----------------|-----|------|-----|-----|----|----|------|
| ASS            | NS (54) | 0.93** (54) | 0.50** (33) | 0.59** (33) | NS (27) | NS (35) | NS (35) |
| JMPQ           | 0.44* (33) | 0.56** (33) | NS (27) | NS (23) | NS (23) | NS (19) | NS (19) |
| PRI            | 0.62** (33) | NS (27) | NS (27) | NS (23) | NS (23) | NS (23) | NS (23) |
| HDL            | 0.40* (35) | NS (23) | NS (23) | NS (19) | NS (19) | NS (19) | NS (19) |

ASS, average sensory score; JMPQ, Japanese version of the McGill Pain Questionnaire; NWC, number of words chosen; PRI, pain rating index; HDL, self-reported degree of hindrance in daily life; SF, self-reported sensory feeling; LT, self-reported length of time worrying; MS-EPQ, Modified Japanese Version of the Short-Form Eysenck Personality Questionnaire; HADS, Japanese version of the Hospital Anxiety and Depression Scale. ( ) indicates number of patients. **P < 0.01; *P < 0.05 (Spearman’s rank correlation coefficient); NS, no significant correlation

Fig. 3 Hypersensitive and hyposensitive cases in each score by thermal stimuli or current perception threshold tests
who developed hypersensitivity than only hyposensitive patients on the second visit. Eight patients showed hypersensitivity in the thermal tests or CPTs on the first visit. On the second visit, seven of them showed hyper-sensitivity and one showed hyposensitivity in all examinations.

Discussion

Following surgical procedures in the oral cavity, patients may develop sensory disturbance such as paresthesia, leading to psychological distress and depression. In this report, the cause of onset was clearly related to recent dental and surgical treatment. Sensory abnormality in the orofacial region may be related to systemic disorders; therefore, clinicians should consider possible implications of systemic disorders such as neurological diseases. In certain diseases, there is a different pattern of abnormal data in quantitative sensory testing [19]. Because of the scoring system to evaluate sensory disturbances by evaluating absolute differences between normal and abnormal side threshold scores, it was difficult to accurately diagnose systemic disorders from changes only in the scoring system. The patients consulted with specialists as soon as possible when they were suspected of having a systemic disease based on their history (i.e., an unknown cause of paresthesia, the site of onset was not typical, and follow-up of changes in sensory thresholds were obviously irregular. Regarding the examination time, patients preferred shorter examination visits. When diagnosing the extent of abnormality in detail, the burden on the patient was taken into consideration. In this study, multiple examinations were conducted targeting different receptors as time permitted, although some patients were unwilling to continue and withdrew from the study.

Similar to previous reports on sensory abnormalities in the orofacial region [20-23], in this study, multiple sensory examinations were conducted to evaluate the function of the third branch of the trigeminal nerve and its receptors. No difficulty was experienced during the examination for the SW and RCS tests. For TPD, some patients were repeatedly unable to distinguish between one- and two-point stimuli on the healthy side, having some difficulty with tactile spatial resolution. W and C were perceptible on the healthy side in all patients, but there were several patients who did not respond to heat stimuli until it reached 50°C (maximum limit) on the healthy side. Although stimulation exceeding 43°C usually activates heat nociceptors on the skin, there may be individual sensory differences. Data from the above-mentioned patients were not included in the analysis of this study.

Compared with the first and second visits, the scores of all sensory examinations were lower at the second visit. On the second visit, only one patient had a sensory score of 0 in all tests, yet all the self-reported symptoms were not 0, suggesting inequality with the sensory test scores. This suggests less necessity to evaluate a patient’s complaint separately from the clinical examination.

The MPQ was initially developed as a method to evaluate painful sensations [16]. The correlation between the JMPQ and sensory test results (ASS) was confirmed in this study, and it suggested that the JMPQ was useful not only for evaluating pain but also for patients with paresthesia. Moreover, the sensory disturbance evaluated by the ASS leads to a cognitive disturbance without affecting the personality or provoking depression and anxiety.

The HADS is effective for examining psychological factors while excluding physical symptoms [18]. A positive correlation was found between anxiety (HADS) and neuroticism (MS-EPQ) scores. This means that the neurotic personality correlates with an increasing sense of anxiety under prolonged sensory abnormality. The psychological response to sensory disturbance depended on an individual’s personality traits. A high score for neuroticism (MS-EPQ) was positively correlated with the degree of anxiety (HADS) score. The correlation between HDL (VAS) and depression (HADS) scores suggests that obstacles of daily life may lead patients to a state of depression. Thus, many patients need psychological support in addition to clinical examination.

There was a correlation between a patient’s self-reported symptoms by the JMPQ and the ASS. This suggests that clinically detectable sensory disturbances also affect patients cognitively. In this study, sensory recuperation at some level was observed in all patients (100%) on the IC of the ASS. However, there was no correlation between the IC of the ASS and the IC of self-reported symptoms (JMPQ and VASs) or the IC of the psychological state (HADS). Besides improvement of overall sensory scores, there was a possibility of deterioration in subjective self-reported symptoms and the psychological state. Considering only whether the IC was positive or negative, the LT (VAS) had the most substantial improvement (85.2%) among self-reported symptoms. The LT (VAS) coincided with hypalgesia in some patients. Although the number of patients surveyed in the LT (VAS) was 27, which was fewer than the JMPQ, HADS, HDL (VAS), and SF (VAS), it suggests that even when patients feel abnormal, it is possible to adapt. The cognitive sense of discomfort may decrease over time. The correlation between the IC of the JMPQ and the IC of HDL (VAS) or SF (VAS) confirms that the efficiency of the JMPQ alone may be sufficient to determine the gravity of self-reported symptoms without VASs. Most importantly, the improvement of sensory test results alone does not lead to a patient’s full recuperation, because the subjective self-reported symptoms and psychological state may deteriorate over time. Thus, psychological and cognitive support to deal with paresthesia is considered necessary. Although sex or age differences were not the influencing factor to alter the subjective sensations over time, it was observed that depressive mood was more improved in older females than in younger males over time.

Hypersensitivity cases were observed in some of the thermal stimuli (W, H and C) and CPTs, whereas only hyposensitivity was observed in the other examinations. Hypersensitivity and hyposensitivity are originally different symptoms, but both are considered abnormal in this survey, and score classification is based only on the absolute difference between the healthy and affected side threshold values. Therefore, in the CPTs and thermal stimuli, similar positive and negative changes are classified as the same score. So the proportion of the two mixed in the same score were investigated. Patients with hypersensitivity showed an increase on the second visit. Some patients complained of hypersensitivity to cold air and hot food or drinks in the lip area during the observation. Hypersensitivity could appear as sensation was being recovered or when sensory abnormality was not severe, because the number of hypersensitivity cases in the second examination was higher than that in the first examination. In this study, the absence of cases diagnosed as allodynia could be a contributory factor that the onset of hypersensitivity did not lead to the worsening of self-reporting declarations.

Conflict of interest

The authors declare no conflict of interest.

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