Patients' perception of sensory disturbances of the mental nerve before and after implant surgery: a prospective study of 110 patients

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SUMMARY. In a randomized controlled clinical trial 110 edentulous patients with severe mandibular bone loss have been treated with ITI-dental implants using three different treatment strategies: (1) a mandibular overdenture supported by two implants with ball attachments, (2) two implants with an interconnecting bar or (3) by four interconnected implants.

As implant surgery involves elevation of the mucoperiosteum, bone remodelling at the implant site and insertion of implants close to the mental foramen, altered sensations of the mental nerve caused by the surgery are to be expected. An altered sensation of the lower lip can also be caused by pressure of an ill-fitting lower denture on the mental foramen, or in the case of severe bone loss of the alveolar ridge, on the alveolar nerve itself.

This article presents the results of the patients' perception of the sensation of their lower lip before, 10 days after and 16 months after implant surgery in the mandible. It shows that 25% of the patients describe a sensory disturbance before treatment. This 25% also showed high scores on the Hopkins Symptoms Check List indicating a tendency to somatize complaints. Eleven percent of the patients report a sensory disturbance in the lower lip 10 days after surgery. Ten percent report a sensory disturbance 16 months after surgery of which one third also reported a disturbance before the treatment.

This implies the risk of a sensory disturbance of the lower lip to be a possible complication after implant surgery. Therefore patients must be informed about this phenomenon before treatment.

INTRODUCTION

Sensory disturbances are well known complications of dental and maxillofacial surgery and have been well documented in the long term evaluation of patients after maxillofacial trauma, third molar and orthognathic surgery, vestibuloplasty and ridge augmentation. Sensory disturbance may also be caused by pressure on the mental foramen or the mental nerve or, in the case of severe mandibular bone loss of the alveolar ridge, by pressure of a (complete) denture on the alveolar nerve itself.1-5

The altered perception may become manifest by the impairment of sensation of the mental nerve. Sometimes just the sensation of pain is disturbed (hypersensitive, hyposensitive or anaesthesia) while in other cases the tactile and temperature senses are affected simultaneously. Paraesthesia is another sensory disorder that results in a numb feeling that is often associated with a burning, prickling sensation of the lower lip and chin. All these changes can be transient or persistent depending on the degree of the irritation of the nerve.1,6

Sensory disturbances also arise after implant surgery but data about them have rarely been reported and are mostly based on retrospective studies.7-11 Early studies7,8 showed a prevalence of temporary paraesthesia that varied from 0–9%. Later studies9,11 showed that the incidence of nerve disturbances might be more widespread. Van Steenberghe et al.9 reported a multicentre study of partially edentulous patients who were treated with implants in which 17% of the patients experienced an altered sensation of the lower lip after implant surgery. Kiyak et al.10 reported that preoperatively 4% of the patients expect some form of sensory disturbance. Two weeks after implant surgery 43% of the patients experienced such a complication. Ellies and Hawker11 reported on a retrospective analysis of a multicentre study which took place in Toronto (Canada) and Adelaide (Australia). Two weeks after implant surgery they found altered sensation of the mandibular alveolar nerve in 37% and 36% of patients respectively. In both centres these complaints were persistent in 13% of the patients. These results were similar to those found by De Koomen1 in edentulous patients treated with a vestibuloplasty and lowering of the floor of the mouth.

MATERIAL AND METHODS

This study is part of the Breda Implant Overdenture Study (BIOS) which is based on a randomized clinical
implants were inserted in the symphysial area under
used. Hollow or full screws were inserted only in
cases in which it was decided during the operation
two part ITI-implants (Straumann, Waldenburg,
Surgical and prosthetic procedures
The implants used in this study are one-stage
implants with Ball Attachments (2IBA), one third a
combined tissue-implant-supported overdenture on
two Implants with a Single Bar (2ISB) and one third an
implant-supported overdenture on four Implants
with a Triple Bar (4ITB).
The 110 patients treated in this study were all
referred to the Ignatius General Teaching Hospital in
Breda, The Netherlands (Department of Special
Dental Care and Maxillofacial Prosthodontics and
the Department of Oral and Maxillofacial Surgery)
between 1991 and 1993. The patients included had
been edentulous in the mandible and maxilla for a
period of at least 5 years and had to have a set of
complete dentures of reasonable quality. The man-
dibular alveolar ridges had to be resorbed to such an
extent that taking patients’ complaints into account,
the prosthodontist thought that new dentures
would not solve the patients’ problems. Exclusion criteria
were possible previous preprosthetic surgery and
physical contra-indications for implant treatment.
All the patients were screened according to a
protocol taking general health, patients’ wants, and
treatment possibilities into account. If an overdenture
on implants was the indicated treatment they were
informed about the three treatments that could be
applied. The patients were asked if they would agree
to undergo any of the three treatments without prior
knowledge of which, until after the computed treat-
ment allocation. The treatment was allocated using a
balancing procedure which was aimed at an equal
distribution of the patients over the treatment groups
regarding the administered balancing criteria. For
this purpose a questionnaire was filled out taking
nine balancing criteria into account (age, sex, the
edentulous period of the mandible and the maxilla,
the number of previously worn mandibular dentures,
the age of the present mandibular denture, the mor-
phology of the maxilla and the mandible, and the
symphysial bone height). The scores on the balancing
criteria are shown in Table 1. The oral and maxillo-
facial surgeon and the prosthodontist were bound
by the computed results. The pre-treatment compar-
ability of the treatment groups was examined by one-
way analysis of variance (ANOVA) and no significant
differences were found.

Surgical and prosthetic procedures
The implants used in this study are one-stage
two part ITI-implants (Straumann, Waldenburg,
Switzerland). In most cases hollow cylinders were
used. Hollow or full screws were inserted only in
cases in which it was decided during the operation
that, because of lack of initial stability, threaded
implants were necessary. The surgical treatment was
done by an oral and maxillofacial surgeon. The
implants were inserted in the symphysial area under
local anaesthesia. The mental foramen was always
identified during the operation and the implants were
inserted at least 3 mm medial to the anterior border
of the mental foramen. Ten days after the sutures
were removed the mandibular denture was adapted to
the mucosa with a tissue conditioning material
(softliner G.C., Japan). Three months after implant
insertion a new maxillary denture and a new man-
dibular implant-overdenture were made. In the case
of an overdenture with ball attachments the matrix
used was a Dalla Bona matrix (Cendres et Métaux,
Switzerland). The bars connecting the two or four
implants in the other two groups were egg-shaped
Dolder bars (CMST53012P20, Cendres et Métaux,
Switzerland). Either one (in the case of two inter-
connected implants) or three (in the case of a triple
bar) corresponding matrices (CMST51012MMR5,
Cendres et Métaux, Switzerland) were incorporated
into the overdenture. The dentures were manufac-
tured with an optimal fit and balanced articulation.
None of the dentures were fitted with a precast metal
reinforcement.

Dependent variables
Before the treatment allocation the patients were
presented with a self-administered questionnaire on
denture satisfaction. It consisted of items referring to
their experience and satisfaction with their mandibu-
lar and maxillary dentures. Each item could be scored
on a four or five point scale. One of the items was
the perception of sensation in the lower lip. The
patients could choose from the options: normal,
prickly, numb or hypersensitive feeling. The patients
were also presented with the somatic questionnaire
from the Hopkins Symptoms Checklist (HSCL) which is a questionnaire used in psychology to esti-
mate a patient’s psychoneurological and/or psycho-
 somatic discomfort. The somatic score of the HSCL
is oriented on physical complaints and shows the
level of a patient’s perception of his/her physical
state. The higher the somatic score the more the
patient tends to exaggerate physical complaints. The
validity data on which the HSCL is based implies
that a high somatic score is often coupled with many
subjective physical symptoms. The patients’ scores
were compared with the HSCL reference scores.

Ten days after insertion of the implants (directly
after removing the sutures) the patients were pre-
presented with a questionnaire in which they were asked
about their experience of the surgical aspects of the
treatment and again about their perception of the
sensation in the lower lip.
Sixteen months after the new dentures had been
inserted they were again questioned about their satis-
faction, now with their new dentures. This question-
naire was identical to the one presented before the
treatment so that the perception of the sensation in
the lower lip was addressed once again. This question-
naire included nine extra questions to evaluate the
patients’ opinion of the surgical treatment. The
patients with subjective disturbances were subjected
to objective nerve testing (soft stroking of the lower
lip and chin with a cotton roll in the case of
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hypoesthesia and pinching with tweezers when they reported anaesthesia). The disturbances were separately recorded for the left and right half of the lip.

RESULTS

Before treatment 110 patients filled out the questionnaire. Two of the patients included in the initial intake decided not to undergo the treatment proposed. Three did not fill out their forms correctly and must be classed as missing values. Table 2 shows the number of patients treated according to allocation.

Table 3 shows that before treatment 27 patients reported a sensory disturbance of the lower lip. Ten days after insertion of the implants 11 patients reported a sensory disturbance of the lower lip as did 10 patients 19 months after the implants had been inserted.

Table 4 shows that three patients reported a sensory disturbance in the lower lip in all three questionnaires. There were no changes in their reported perception during the follow-up period. Eleven patients reported a sensory disturbance 10 days after the implants had been inserted. Three had possibly had the disturbance before the operation meaning that 8 patients may have developed altered sensation during or directly after the operation.

Of the patients with sensory disturbances directly after implant insertion four were to have ball attachments. Five had received two implants which were to be connected with a bar and two had received four implants which were to be connected by a triple bar. Of the four patients who developed complaints during the 19-month period after implant insertion, three had two implants with ball attachments and one had four implants.

Another question asked in the questionnaire was 'Does your denture cause pain in your mouth?' Table 5 shows that 26 out of the 27 patients who expressed an altered sensation before treatment answered this question with 'yes'. In the group without altered sensation before treatment this percentage recorded a sensory disturbance of the lower lip. Ten days after insertion of the implants 11 patients reported a sensory disturbance of the lower lip as did 10 patients 19 months after the implants had been inserted.

Table 4 shows that three patients reported a sensory disturbance in the lower lip in all three questionnaires. There were no changes in their reported perception during the follow-up period. Eleven patients reported a sensory disturbance 10 days after the implants had been inserted. Three had possibly had the disturbance before the operation meaning that 8 patients may have developed altered sensation during or directly after the operation.

Nineteen months after operation 10 patients still reported sensory disturbance. Three of them had already reported this before the operation and an additional three 10 days after the operation. Four patients had developed their complaints during the year after operation while wearing the overdentures. Objective nerve testing confirmed the disturbances described by the patients after 19 months.

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Table 1 - Characteristics study sample at the baseline according to balancing criteria. Figures are number (%) of patients unless otherwise stated.

<table>
<thead>
<tr>
<th></th>
<th>2IBA (n = 36)</th>
<th>2ISB (n = 37)</th>
<th>4ITB (n = 37)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>50</td>
<td>51.3</td>
<td>53.1</td>
</tr>
<tr>
<td>Range</td>
<td>33–80</td>
<td>35–76</td>
<td>35–81</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14 (39)</td>
<td>8 (22)</td>
<td>12 (32)</td>
</tr>
<tr>
<td>Female</td>
<td>22 (61)</td>
<td>29 (78)</td>
<td>25 (68)</td>
</tr>
<tr>
<td>Edentulous period mandible (SD)</td>
<td>22.5 (8)</td>
<td>20.7 (9)</td>
<td>23.1 (9)</td>
</tr>
<tr>
<td>Mean number of mandibular dentures (SD) previously worn</td>
<td>3.3 (1.3)</td>
<td>3.3 (1.9)</td>
<td>3.3 (1.9)</td>
</tr>
<tr>
<td>Mean age (SD) of present mandibular denture (years)</td>
<td>5.3 (4.3)</td>
<td>5.2 (4.8)</td>
<td>5.1 (4.1)</td>
</tr>
<tr>
<td>Contour maxilla</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>25 (69)</td>
<td>25 (68)</td>
<td>24 (65)</td>
</tr>
<tr>
<td>Moderate</td>
<td>10 (28)</td>
<td>12 (32)</td>
<td>12 (32)</td>
</tr>
<tr>
<td>Bad</td>
<td>1 (3)</td>
<td>0</td>
<td>1 (3)</td>
</tr>
<tr>
<td>Contour mandible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>5 (14)</td>
<td>4 (11)</td>
<td>4 (11)</td>
</tr>
<tr>
<td>Moderate</td>
<td>15 (42)</td>
<td>16 (43)</td>
<td>16 (43)</td>
</tr>
<tr>
<td>Bad</td>
<td>16 (44)</td>
<td>17 (46)</td>
<td>17 (26)</td>
</tr>
<tr>
<td>Mean (SD) symphysial bone height</td>
<td>17 (3)</td>
<td>15.7 (4)</td>
<td>15.5 (3.3)</td>
</tr>
<tr>
<td>Mean (SD) thickness cortex at gonion</td>
<td>1.5 (0.9)</td>
<td>1.9 (0.8)</td>
<td>1.8 (0.9)</td>
</tr>
</tbody>
</table>

2IBA = 2 Implants with ball attachments.
2ISB = 2 Implants connected by a single bar.
4ITB = 4 Interconnected implants.

Table 2 - Number of patients treated according to randomization

<table>
<thead>
<tr>
<th></th>
<th>2IBA</th>
<th>2ISB</th>
<th>4ITB</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>36</td>
<td>37</td>
<td>37</td>
<td>110</td>
</tr>
<tr>
<td>Withdrew consent</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Incomplete data</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Total before treatment</td>
<td>34</td>
<td>35</td>
<td>36</td>
<td>105</td>
</tr>
<tr>
<td>Total followed up at 10 days</td>
<td>33</td>
<td>35</td>
<td>35</td>
<td>103</td>
</tr>
<tr>
<td>Total followed up at 16 months</td>
<td>33</td>
<td>34</td>
<td>35</td>
<td>102</td>
</tr>
</tbody>
</table>

Table 3 - Perception of sensation in the lower lip

<table>
<thead>
<tr>
<th></th>
<th>Before treatment</th>
<th>At 10 days (n = 105)</th>
<th>At 16 months (n = 102)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>78 (74)</td>
<td>92 (89)</td>
<td>92 (90)</td>
</tr>
<tr>
<td>Prickly</td>
<td>6 (6)</td>
<td>2 (2)</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Numb</td>
<td>6 (6)</td>
<td>4 (4)</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Hypersensitive</td>
<td>15 (14)</td>
<td>5 (5)</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Figures are number (%) of patients.
was 74%. This difference is significant (Fisher’s exact test $P=0.012$).

The analysis of the patients’ answers to the HSCL (Table 6) shows that the patients who described an altered sensation in the lower lip before treatment had a significantly higher HSCL score than those who did not (Mann Whitney U test). The mean (SD) score was 5.9 (3.1). The reference scale for normal people meaning here non-psychiatric and non-psycho somatic has a scoring range from 0 to 12 and a mean scoring bracket has been set between 1 and 3. A high score is defined between 3 and 6 and a very high score is 7 and above. The mean (SD) of 5.9 (3.1) scored by the patients who reported a sensory disturbance is therefore a high score for normal people meaning that they may possibly be inclined to somatic complaints. The patients in our trial who did not express an altered sensation in the lower lip before treatment had a mean (SD) HSCL-score of 2.6 (1.2).

### DISCUSSION

Altered sensation in the lower lip can be caused by several factors. In patients with severe mandibular bone loss, pressure of the denture on the alveolar nerve across the mucosa and the periosteum might cause neurosensory disturbance. Other explanations might be stretching of the mental nerve with a retractor during the implant operation, pressure on the nerve by oedema as a reaction to the operation, pressure caused by a haematoma or scar formation. This kind of disturbance is, however, reversible in most cases. If the implants are placed close to the alveolar nerve without actually damaging it, patients can experience altered sensation at irregular intervals, for instance when exposed to relatively high or low temperatures during eating. A fourth possibility is an unintentional lesion of the alveolar nerve (or the anterior loop) during the implant operation. This kind of damage may lead to permanent neurosensory deficit or disturbed sensation of pain.

Contrary to what was expected, more patients reported sensory disturbance of the lower lip while wearing inadequate dentures (25%) than they reported directly after or 19 months after implant insertion and prosthetic treatment. This phenomenon was also reported by Wittenburg and Small in a study on mandibular reconstruction with hydroxyapatite and a staple bone implant. This might be explained by the pressure of the dentures on the denture-bearing area in the region of the mental foramen which would...
irritate the mandibular nerve. As the patients were not allowed to wear their lower dentures during the three weeks after the implant operation, sensory disturbance was reported by only three of these patients 10 days after the operation.

The patients' psychosomatic state may also explain the large number of patients who reported an altered sensation before treatment. The significantly higher HSCL score of the complainers compared with the non-complainers before treatment confirms this. Because these patients complain significantly more about the pain in their mouths caused by their dentures (96%) compared with the non-complainers (74%) they may have a higher awareness of their physical state.

Only 11 (11%) of the patients treated reported a sensory disturbance directly after operation. Of these 11, three already had the disturbance before the implant treatment. These results do not agree with those reported by Ellies and Hawker in which a comparable group of patients was evaluated. In that study 35–40% of the patients treated had sensory disturbances directly after the operation. In that study, however, the patients were treated by different oral surgeons using different implant systems and possibly following different surgical procedures.

In our study 10% of the patients still had complaints 16 months after surgery compared to 13% after 15 months in the study by Ellies and Hawker. These results agree with those of a former 6.5-year retrospective study carried out in the Ignatius Hospital in which 14% of the patients expressed an altered sensation in their lower lip after implant-overdenture treatment. On the other hand, 3 of the 10 with complaints after 19 months had already complained before the operation. This means that 7 of the patients have developed their complaints after the implants had been inserted.

Of the four patients who developed sensory disturbances while wearing their implant-supported overdentures, three had overdentures on ball attachments. This type of overdenture is supported more by the mucosal tissue than the other overdentures which are supported by bars and so may cause more pressure in the region of the mental foramen and on the alveolar nerve resulting in altered sensation in the lower lip. The fourth patient had reported a form of sensory disturbance before treatment and did not do so 10 days afterwards. It was reported again at the evaluation after 16 months.

The mental foramen was always identified during the operation and the implants were all inserted at least 3 mm mesial to the anterior border of the mental foramen. Recent research on cadavers has shown that the mandibular nerve does not make such an extreme mesial loop as one might expect when examining radiographs of this region. A 1 mm safety margin, instead of the 3 mm we comply with, is probably acceptable in most cases. Whether this is advisable or not, cannot be concluded from the results of this study. The 3 mm safety margin in our treatment protocol still results in sensory disturbance in the lower lip in 7% of cases.

It can be concluded that the risk of sensory disturbance after implant insertion in the intraforaminal area of an edentulous mandible and the wearing of an implant-supported overdenture is a complication that develops in about 7% of cases. This means that patients must be warned about it before treatment. The results of this study have also shown that a sensory disturbance of the lower lip present before implant insertion and overdenture treatment, in an edentulous patient who has not undergone previous preprosthetic surgery, disappears in most cases.

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