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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 studies[7,8] showed a prevalence of temporary paraesthesia that varied from 0–9%. Later studies[9,11] 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 Hawker[11] 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 Koomen[1] 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

trial designed to evaluate implant treatment in totally edentulous patients with denture problems. The trial consisted of 110 patients. They were treated by one of three treatment protocols. One third was to have a mainly tissue-supported overdenture on two 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 mandibular 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 treatment allocation. The treatment was allocated using a balancing procedure[12] 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 morphology 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 maxillofacial surgeon and the prosthodontist were bound by the computed results. The pre-treatment comparability 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 mandibular 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 interconnected 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 manufactured with an optimal fit and balanced articulation.[13] 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 mandibular 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 estimate a patient's psychoneurological and/or psychosomatic discomfort.[14] 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.[15]

Ten days after insertion of the implants (directly after removing the sutures) the patients were 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 satisfaction, now with their new dentures. This questionnaire 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 questionnaire 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

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

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

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

hypersensitivity 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.

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.

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

Table 2 – Number of patients treated according to randomization

	2IBA	2ISB	4ITB	Total
Baseline	36	37	37	110
Withdrew consent	1	0	1	2
Incomplete data	1	2	0	3
Total before treatment	34	35	36	105
Total followed up at 10 days	33	35	35	103
Total followed up at 16 months	33	34	35	102

Table 3 – Perception of sensation in the lower lip

	Before treatment ($n=105$)	At 10 days ($n=103$)	At 16 months ($n=102$)
Normal	78 (74)	92 (89)	92 (90)
Prickly	6 (6)	2 (2)	2 (2)
Numb	6 (6)	4 (4)	7 (7)
Hypersensitive	15 (14)	5 (5)	1 (1)

Figures are number (%) of patients.

Table 4 – Comparison of sensory disturbances after in those patients who had impaired sensation before or after implant treatment

Case number	Before treatment		Immediately after		16 Months later		Treatment
	Left	Right	Left	Right	Left	Right	
47	Normal	Normal	Prickly	Prickly	Normal	Normal	2IBA
49	Normal	Normal	Hyp. Sen	Hyp. Sen	Normal	Normal	2ISB
50	Normal	Normal	Normal	Normal	Numb	Numb	2IBA
53	Normal	Normal	Normal	Normal	Hyp. Sen	Normal	2IBA
54	Normal	Normal	Normal	Normal	Prickly	Prickly	2IBA
59	Normal	Normal	Numb	Normal	Numb	Normal	4ITB
69	Normal	Normal	Normal	Hyp. Sen	Normal	Numb	4ITB
73	Normal	Normal	Numb	Numb	Normal	Normal	2ISB
77	Normal	Normal	Normal	Numb	Normal	Numb	2ISB
80	Normal	Normal	Hyp. Sen	Prickly	Normal	Normal	2IBA
85	Normal	Normal	Hyp. Sen	Hyp. Sen	Normal	Normal	2ISB
86	Normal	Normal	Numb	Normal	Numb	Normal	2IBA
87	Numb	Numb	Hyp. Sen	Hyp. Sen	Numb	Numb	2ISB
95	Hyp. Sen	Normal	Normal	Normal	Prickly	Normal	4ITB
98	Hyp. Sen	Hyp. Sen	Prickly	Prickly	Prickly	Numb	2IBA

Hyp. Sen = hypersensitive feeling.
2IBA; 2 Implants with ball attachments (Dalla Bona).
2ISB; 2 Implants with a single bar.
4ITB; 4 Implants interconnected by a triple bar.

Table 5 – Amount of pain in the mouth correlated with the perception of feeling in the lower lip before treatment. Figures are number (%) of patients

Perception of sensation	Amount of pain					Total
	A lot	Some	No opinion	A little	None	
Normal	31 (40)	27 (35)	4 (5)	12 (15)	4 (5)	78
Abnormal	23 (83)	3 (11)	0	1 (4)	0	27
Total	54 (51)	30 (29)	4 (4)	13 (12)	4 (4)	105

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).

Table 6 – Hopkins symptoms checklist scores

	HSCL score
Extremely high	7 or more
High	3–6
Average	1–2
Below average	0
Mean scores (SD) in this study:	
Complainers	5.9 (3.1)
Non complainers	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.[16] 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.[17] 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[11] 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.[11] 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.[18] 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[16] 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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