

# Prosthetic Rehabilitation of Head and Neck Cancer Patients Focusing on Mandibular Dentures in Irradiated Patients

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**Purpose:** This retrospective study assessed treatment outcomes and patient satisfaction of irradiated head and neck cancer patients treated with mandibular implant overdentures (IODs) or conventional dentures (CDs). **Materials and Methods:** Fifty-one irradiated head and neck cancer patients, out of a total of 158 patients included, completed the standardized questionnaire and underwent a clinical assessment. Nineteen patients were treated with removable CDs and 32 patients received IODs between January 2006 and January 2011. The mean follow-up of patients was 5.75 years (range: 1 to 23 years). **Results:** A total of 45 (88.3%) mandibular dentures were in function at the time of assessment. The overall denture satisfaction was 7.3 (range: 1 to 10, SD: 2.14). Patients being treated with adjuvant concepts, including surgical tumor ablation, scored worse than patients after radiation therapy alone. Edentulous patients seem to benefit from implants, especially with respect to prosthesis retention. Men take more benefit from IODs compared with women. **Conclusions:** The results are comparable to other studies of head and neck cancer patients and also of healthy individuals. Surgical interventions in adjuvant therapy concepts lead to reduced denture satisfaction. The concept of prosthetic rehabilitation as part of oncologic treatment can be judged as successful. *Int J Prosthodont* 2013;26:557–562. doi: 10.11607/ijp.3496

Treatment of head and neck cancer has an enormous impact on patients' lives. Therapy-related functional and esthetic problems directly influence the outer appearance, social interaction, and oral functions such as mastication, swallowing, speech, and nutrition of patients.<sup>1–3</sup> Current advances in microsurgery in combination with dental implants have led to better functional and esthetic outcomes.<sup>4</sup> However, radiation therapy and chemotherapy still cause unfavorable side effects such as reduced

swallowing ability, xerostomia, and a painful and tender mucosa.<sup>2,3,5</sup> These side effects have an impact on quality of life (QoL) and may last forever.<sup>3,6–8</sup>

In the rehabilitation process, after tumor treatment, prosthetic rehabilitation plays a prominent role in improving oral functions and QoL.<sup>7,9</sup> Implant-retained overdentures (IODs) are a standard treatment in head and neck cancer patients. Several studies in irradiated and nonirradiated patients presented high implant survival rates varying from 69% to nearly 99%.<sup>4,10,11</sup> However, the percentage of head and neck oncology patients who are rehabilitated with the use of implants widely varies from 22% to 91%.<sup>7</sup> There are different reasons for this variation. Among others, survival rate, length of follow-up, and financial aspects play important roles depending on local insurance regulations.

A positive correlation can be found between denture satisfaction and overall QoL in head and neck cancer patients.<sup>12</sup> There is some evidence regarding better outcomes for IODs in edentulous individuals compared with conventional dentures (CDs).<sup>13,14</sup> For irradiated edentulous patients, the same assumptions have been made.<sup>10,11,15</sup> This might imply that IODs increase denture satisfaction and overall QoL in head and neck cancer patients. Thus, prosthetic rehabilitation appears to aid in a successful overall treatment of head and neck cancer.

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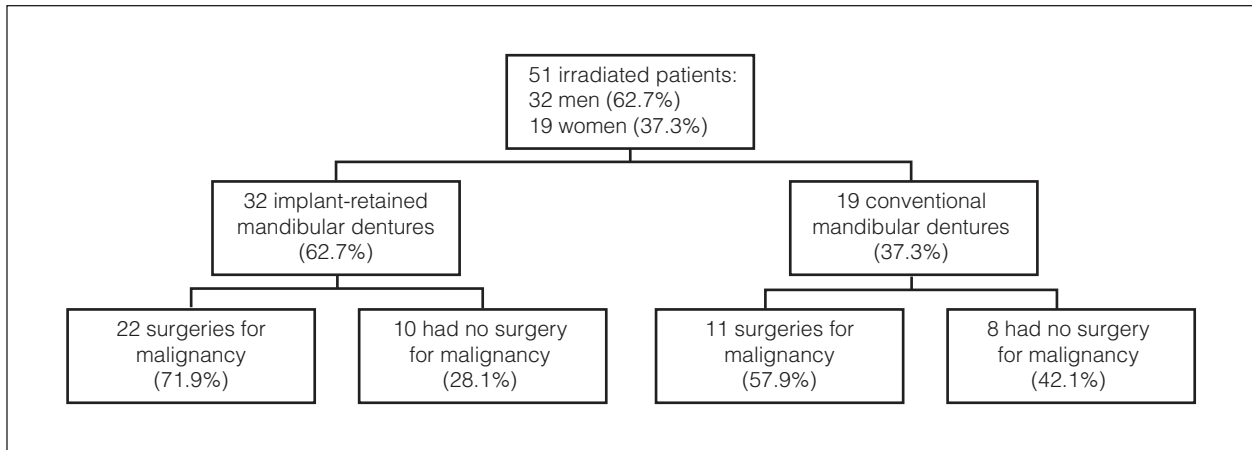
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**Fig 1** Classification of patients who completed the assessment and questionnaires.

**Table 1** Patient and Tumor Characteristics

Patient	n	Minimum	Maximum	Mean	SD
Mean age (y)	51	52	84	67.2	7.586
Edentulous mandible (y)	50	1	46	12.8	14.739
Follow-up (y)	51	1	23	5.75	4.293
Sex					
M	32	(62.7%)			
F	19	(37.3%)			
Tumor location					
Oral	23	(45.1%)			
Oropharynx	14	(27.5%)			
Laryngopharynx	11	(21.6%)			
Other	3	(5.9%)			
Surgery					
Y	33	(64.7%)			
N	18	(35.3%)			
Bony defect					
Without	44	(86.3%)			
Partial	0	(13.7%)			
Continuity	7				

The objectives of this retrospective study were threefold: to assess the overall percentage of functioning IODs and CDs and to determine patient satisfaction with dental rehabilitation with respect to QoL in both the IOD and CD groups.

Data acquisition was based on patients treated for primary head and neck cancer at the Maastricht University Medical Center (MUMC) who had to undergo radiation therapy at the Maastricht clinic between January 2006 and January 2011.

## Materials and Methods

One hundred fifty-eight patients suffering from head and neck cancer were extracted from the overall population of head and neck cancer patients of the Department of Cranio-Maxillofacial Surgery, MUMC. The authors made a list of patients for whom dental technician work had been done. Their medical files were then reviewed to determine if they were edentulous, had received an IOD or CD between January 2006 and January 2011, and if radiation therapy had been mentioned. All patients received an invitation and response letter for participation in this study. The total response rate was 68.4% (n = 108).

Sixty-nine patients agreed to participate, 30 patients refused, 5 patients were not irradiated for various reasons, 1 patient died, 3 patients moved, and 50 did not respond to the letter. All patients ready to participate in the study were invited to visit the clinic to complete a questionnaire. They were assisted by a researcher. Of the 69 people invited by phone, 13 failed to show up for their appointment, 2 fell ill, 1 responded too late to the invitation, and 2 appeared but refused to answer the questions.

A total of 51 patients, 32 (62.7%) men and 19 (37.3%) women, completed the questionnaires (Fig 1). All patients were seen by the same researcher (LV). The oncologic and medical history, as well as any current medications, were recorded. The following data were obtained: tumor classification according to the TNM classification, tumor location, oncologic treatment, and whether or not the patient was irradiated by intense modulated radiation therapy (Table 1). The dimensions of the surgical defect in the mandible

were classified as partial defects (box and slice osteotomies) and continuity defects, with or without bony reconstruction. There were five cases of maxillary resections. The center of attention, however, was on the mandible as the radiation doses were focused on the lower third of the face and neck. This region is more susceptible to functional impairment due to the fact that the tongue is situated in the irradiation field and, therefore, speech and swallowing are affected. A dental anamnesis was done followed by an oral examination (Table 2). The oral conditions and the state of the prosthetic rehabilitation were noted. The medical and dental anamnesis were standardized and completed with information from the patients' medical records.

The questionnaire entitled "Satisfaction of the denture" was filled in together with the researcher (LV). General QoL was assessed with the Linear Analogue Self-Assessment method (one-item version). Overall denture satisfaction was expressed on a 10-point rating scale, range 1 to 10, 1 being completely dissatisfied and 10 being completely satisfied.<sup>9</sup> More detailed information about denture satisfaction was assessed using a validated questionnaire consisting of eight separate items focusing on the function of maxillary and mandibular dentures and on specific features such as esthetics, retention, and functional comfort. All questions could score 1 to 5, 1 being most satisfied and 5 being most unsatisfied.<sup>16</sup> All data were evaluated using SPSS (IBM, version 18.0 for Mac).

### Results

Of the total number of patients (n = 51), 32 had an IOD and 19 a CD (Fig 1). The patient characteristics are shown in Table 1.

In the 32 patients with an IOD, a total of 73 implants were placed in the mandible. Overall implant survival was 97.3% (71/73), and 95.9% (70/73) of the implants were in function after a mean time of 48.6 months (range: 14 to 132 months, SD: 32.1 months). Two implants were lost, one at stage-two surgery and the other due to malpositioning. In one patient, one of three implants was not activated, as it was not needed for the prosthetic rehabilitation.

Most of the patients (n = 45, 88.3%) used their mandibular dentures (Table 3). Reasons for being unable to wear the mandibular denture were: anatomical changes in the oral cavity due to ablative surgery, pain, temporomandibular joint dysfunction, and dissatisfaction with design and esthetic aspects of the denture.

Overall denture satisfaction was obtained separately for the complete prosthetic restoration and for the mandibular denture (Table 4). There was no

**Table 2** Dental Anamnesis and Oral Assessment as Administered

<b>Dental anamnesis:</b>
Edentulous since?
Age at first mandibular denture?
Do you wear your mandibular denture? Why not?
<b>Oral assessment:</b>
Dental status? Maxilla edentulous?
Implant status for mandible? How many implants?
Stable implants?
Dutch Periodontal Screening Instrument for implants and possible teeth in the maxilla
Condition of oral mucosa? Blister or ulcer by denture?
Soft tissue defect?

**Table 3** Frequencies of Patients Wearing Their Dentures\*

	Frequency	%
Yes	39	76.5
Most of the time	6	11.8
Mostly no	4	7.8
Never	2	3.9
Total	51	100

\*Patients answering "yes" or "most of the time" were scored as "wearing their denture." Patients answering "mostly no" or "never" were scored as "not wearing their denture."

**Table 4** Denture Satisfaction Scores for the Total Group\*

	n	Minimum	Maximum	Mean
Overall denture satisfaction	49	1	10	7.3
Mandibular denture satisfaction	48	1	10	7.4

\*Range: 0 to 10 with 0 being completely dissatisfied and 10 being completely satisfied. The missing patients were not able to wear their dentures because of changes in anatomy due to recent surgery.

difference in overall denture satisfaction between the CD group (mean: 7.33, SD: 1.97) and the IOD group (mean: 7.29, SD: 2.26) (Table 5). The slight difference in overall mandibular denture satisfaction between the CD group (mean: 6.88, SD: 1.80) and the IOD group (mean: 7.73, SD: 2.50) was not significant. A detailed analysis showed a significant difference for the item "retention" in favor of the IOD group (mean: 1.77, SD: 0.83) versus the CD group (mean: 2.50, SD: 1.16) (Table 5).

**Table 5** Comparing the CD Group with the IOD Group\*

	CD mean (n = 18)	IOD mean (n = 31)	Total (mean)	P
Overall denture satisfaction	7.3333	7.2903	7.3061	.947
Mandibular denture satisfaction	6.8824	7.7258	7.4271	.227
Retention	2.5000	1.7742	2.0408	.014

\*For the items "overall denture satisfaction" and "mandibular denture satisfaction," the range was 0 to 10 with 0 being completely dissatisfied and 10 being completely satisfied. For "retention," 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, and 5 = very dissatisfied.

**Table 7** Significant Differences for Men with CDs vs Men with IODs\*

	CD (n = 10)	IOD (n = 20)	Total	P
Mandibular denture satisfaction	6.5556	8.4750	7.8793	.003
Mandibular denture	2.4444	1.6000	1.8621	.009
Retention	2.6000	1.6500	1.9667	.016

\*For the item "mandibular denture satisfaction," the range was 0 to 10 with 0 being completely dissatisfied and 10 being completely satisfied. For "mandibular denture" and "retention," 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, and 5 = very dissatisfied.

**Table 8** Differences Between Patients Who Underwent Surgery and Radiation Therapy vs Patients Who Underwent Radiation Therapy Alone\*

	Surgery and radiation therapy (n = 31)	Radiation therapy alone (n = 18)	Total	P
Appearance	2.1613	1.4444	1.8980	.012
Speaking	2.2903	1.5000	2.0000	.006
Eating	2.3548	1.7778	2.1429	.087

\*For the items "appearance," "speaking," and "eating," 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, and 5 = very dissatisfied.

In regard to sex, there were no significant differences found in the CD group; however, significant differences were found in the IOD group. Men scored better in "overall denture satisfaction" and "overall mandibular denture satisfaction," specifically with regard to "mandibular denture" and "appearance." The items "functional comfort" and "speaking" were also judged more favorably by men than women (Table 6).

Regarding men, the difference in "overall mandibular denture satisfaction" became significant in favor of the IOD group, and in addition to the item "retention,"

**Table 6** Mean Scores for the IOD Group\*

	Men (n = 20)	Women (n = 11)	Total	P
Overall denture satisfaction	8.0250	5.9545	7.2903	<b>.012</b>
Mandibular denture satisfaction	8.4750	6.3636	7.7258	<b>.022</b>
Denture satisfaction				
General	1.9444	2.7273	2.2414	.076
Maxillary denture	2.1765	2.8000	2.4074	.217
Mandibular denture	1.6000	2.4545	1.9032	<b>.037</b>
Appearance	1.7000	2.5455	2.0000	<b>.017</b>
Retention	1.6500	2.0000	1.7742	.265
Functional comfort	1.8750	2.8182	2.2097	.052
Eating	1.9500	2.6364	2.1935	.109
Speaking	1.8500	2.6364	2.1290	.060

\*For the items "overall denture satisfaction" and "mandibular denture satisfaction," the range was 0 to 10 with 0 being completely dissatisfied and 10 being completely satisfied. For items under the "denture satisfaction" heading, 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, and 5 = very dissatisfied. Bold numbers indicate statistical significance ( $P \leq .05$ ).

**Table 9** Differences Between Patients Without a Bony Defect vs Patients With a Total Mandibular Defect\*

	Without bony defect (n)	Total mandibular defect (n)	Total	P
Overall denture satisfaction	7.4091 (44)	6.4000 (5)	7.3061	.323
Mandibular denture satisfaction	7.5114 (44)	6.5000 (4)	7.4271	.405
Denture satisfaction				
General	1.9767 (43)	2.7500 (4)	2.0426	.174
Maxillary denture	2.0732 (41)	2.5000 (4)	2.1333	.329
Mandibular denture	1.9545 (44)	2.5000 (4)	2.0000	.326
Appearance	1.8409 (44)	2.4000 (5)	1.8980	.233
Retention	2.0455 (44)	2.0000 (5)	2.0408	.926
Functional comfort	2.1705 (44)	2.2000 (5)	2.1735	.960
Eating	2.0227 (44)	3.2000 (5)	2.1429	<b>.027</b>
Speaking	1.8864 (44)	3.0000 (5)	2.0000	<b>.017</b>

\*For the items "overall denture satisfaction" and "mandibular denture satisfaction," the range was 0 to 10 with 0 being completely dissatisfied and 10 being completely satisfied. For items under the "denture satisfaction" heading, 1 = very satisfied, 2 = satisfied, 3 = neutral, 4 = dissatisfied, and 5 = very dissatisfied. Bold numbers indicate statistical significance ( $P \leq .05$ ).

"mandibular denture" also scored significantly better in the IOD group (Table 7).

When comparing patients after adjuvant therapy with patients after radiation therapy alone, there was a significantly better score for "appearance and speaking" from the group that underwent radiation therapy alone. For "eating" there was a strong trend in favor of the radiation therapy alone group (Table 8). Patients with mandibular continuity resection scored significantly worse on the items "eating and speaking" (Table 9).

## Discussion

According to the Dutch guidelines for the treatment of head and neck cancer, many patients are bound to lose some or even all of their teeth. Prosthetic rehabilitation in these cases is mostly done with partial or complete dentures. Today, the Dutch health care system supplies two interforaminal dental implants in the mandible for patients having trouble using their dentures and who have a strongly resorbed mandible.

In comparison to the literature, good results were registered, with 88.3% (45 of 51, Table 3) of mandibular dentures in function after a variable time of follow-up (range: 1 to 23 years) (Table 1).<sup>10,11</sup>

The overall denture satisfaction in the examined population was relatively high, with a mean of 7.3 out of 10. This is comparable to other studies of patients with oral cancer as well as of healthy patients.<sup>9,10,17</sup>

Prospective randomized studies show that patients are more satisfied with an IOD compared to a CD.<sup>13</sup> This study on irradiated head and neck cancer patients also found a better, but not significant, overall mandibular denture satisfaction for IOD rehabilitation. The only significant factor found was "retention." If we split the group into men and women, the men scored significantly higher in "overall mandibular denture satisfaction" and "mandibular denture." In the women's group, no significant difference between IODs and CDs was noted. These results may have been influenced by the fact that the women more frequently underwent surgery. Only 17 of 32 (53%) men underwent surgery, but 15 of 18 (83%) women did. Unfortunately, the remaining group of women that were only irradiated was too small to confirm these assumptions.

Comparable differences were also found between men and women in the Pan et al study.<sup>17</sup> However, Pan et al found these differences in the CD group, whereas the present study found them in the IOD group. Although the present group was compromised by the oncologic treatment, it can be concluded that women are less satisfied with their dentures than men.

Concerning the items "appearance and speaking," surgical patients scored worse than irradiation only patients. Significance was found for patients after continuity resections of the mandible. The items "eating and speaking" were judged significantly worse by this group of patients. Although these findings were significant, one has to consider that only seven patients had continuity resection, of whom only five were able to wear dentures.

The total response rate was 68.4%. This is higher than that reported in the literature; however, of those having responded to the invitation letter, only 47%

(51 of 108) were willing to participate. This is comparable to other retrospective questionnaire studies.<sup>3,18</sup>

## Conclusions

Irradiated edentulous patients seem to benefit from implant-retained prostheses in the mandible, especially with respect to prosthesis retention. Men appear to benefit more from IODs than women. Mandibular surgery has a negative influence on denture satisfaction.

From a standpoint of prosthetic rehabilitation, any operation that changes the anatomical structure of the mandible has to be avoided. This demand is difficult to practice as today's oncologic studies still present high rates of T3 and T4 cancers of the oropharyngeal region affecting the jaw. The only means of achieving this goal is prevention and education through better information for patients and professionals concerning premalignant lesions and early cancer treatment to avoid mutilating surgery.

## Acknowledgment

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#### Literature Abstract

#### Do the smiles of the world's most influential individuals have common parameters?

The objective of this study was to determine whether there were any common measurable parameters correlated with the smiles of the world's most influential individuals based on the most recent yearly listings. A total of 168 subjects were selected from the lists of Time magazine's 100 most influential people within the years 2006 to 2010. Smiling frontal view photographs were obtained. Thirty-six variables for each subject were traced and measured by photogrammetric analysis to obtain qualitative and quantitative proportions and measurements. Irrespective of sex or occupation, the similar quantifiable characteristics of the smiles of the most influential subjects were as follows: facial proportion, smile width, vertical upper lip proportion, incisor height exposure, buccal corridor ratio, smile symmetry index, and intradental proportions. Other qualitative standards were as follows: smile symmetry, the buccal corridors and smile arc, occlusal cant, and the discrepancy between maxillary and facial midlines. The smiles of the world's most influential people demonstrated common standards, regardless of occupation or sex, which may play a decisive role in the facial expressions of influential individuals.

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